Market Analysis
Coastal Aggregate Development Opportunities

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EXECUTIVE SUMMARY

The objective of this study is to provide an overview of the western North American coastal market for BC construction aggregates. This information may assist the provincial government in considering ways to support First Nations business partnerships and Coastal communities to better position themselves to capture a share of this expanding export market.

Background

- Natural construction aggregates include sand and gravel and crushed stone or rock, which is used in its natural state or after mechanical processing, including crushing, washing and sizing.
- Aggregate is the chief raw material used in Portland cement concrete and asphalt, which are universally used for construction and road paving purposes.
- Most commercially produced aggregates are used in public works projects, thus any changes in costs maybe passed on to the public through higher costs of public service and higher taxes.
- An important characteristic of the industry is that it is very competitive (i.e. narrow margins), the dominant companies are often highly integrated with cement companies having subsidiaries in the both the ready-mix and aggregate business.
- Although, aggregates are relatively inexpensive at its source, the cost of transportation is often the major factor in determining the competitive cost to the consumer.

Export Market

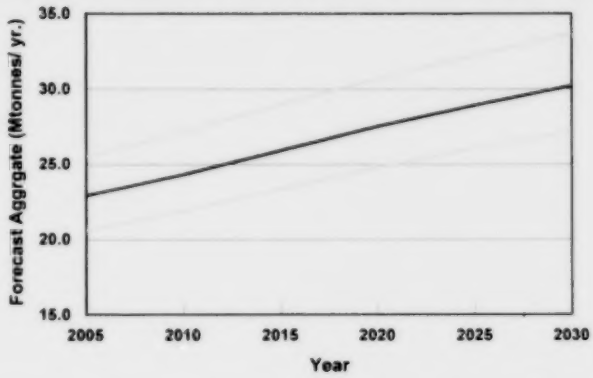
- Although BC has exported aggregate and lime rock by barge to US markets for decades, over the last several years BC has been shipping large tonnages of aggregates by Canadian Steamship Lines (CSL) in Panamax-size ships to California.
- In 2002, CSL carried 800,000 tonnes of sand and gravel to San Francisco from Sechelt and 700,000 tonnes of construction rock into Los Angeles/Long Beach from Texada Island.
- This emerging export market has developed as a result of a favorable backhaul on the CSL ships (hauling gypsum from Baja northward), port developments and increasing California demand.
- California is a particularly attractive market for BC suppliers because it has a large population (35 million/Canada 32 million), it is experiencing rapid coastal urbanization, depleting aggregate reserves and regulatory problems facing many in-state producers.

British Columbia

- The market area for marine suppliers does not extend very far inland, because trucking cost increases rapidly to a point where inland suppliers can supply customers less expensively than hauling from the coast.
- Although, the Vancouver Island Highway Project and the third runway at the Vancouver Airport had a noticeable impact on BC consumption over the early 1990's -- since then, consumption has declined from a high of 47 million tonnes/yr. in 1995 to 38 million tonnes/yr. in 2002 -- a result of depressed levels of capital investment.

- Future coastal aggregate demand is estimated to increase from 22.8 million tonnes (50 percent of the provincial total) in 2005 to 30.2 million tonnes in 2030.

Figure ES-1
BC Coastal Aggregate Requirements High, Medium and Low Forecast 2005 to 2030



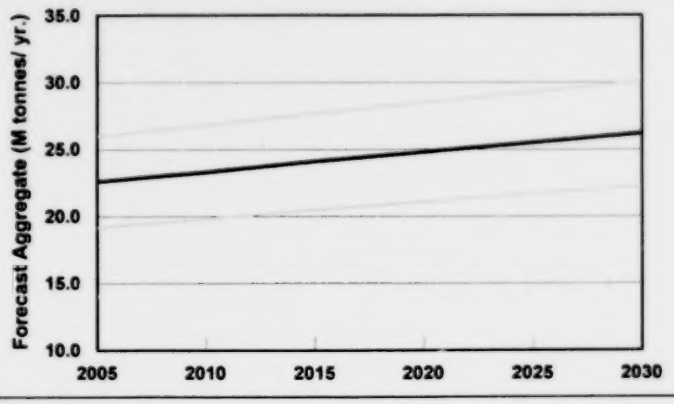
- The 'Medium Growth' scenario suggests that by 2030 coastal requirements for aggregate will increase by over 7.0 million tonnes/yr., which is more than twice the current output of BC's largest operation at Sechelt at 3.1 million tonnes/yr.
- Although there is excess capacity in several of the coastal operations, addition investment at existing operations and new aggregate production capacity will be required to meet domestic and export requirements.
- The major BC exporters operate on private land and typically are large multinational firms with US distribution affiliates or subsidiary companies in key California ports.

California

- By far, California is the most important market for BC aggregates as local reserves are being depleted and in-state coastal producers are being displaced by rising land values and difficulties in obtaining site approvals.
- In 2002, California produced a total of 223 million tonnes of aggregates, including 159 million tonnes of sand and gravel and 64 million tonnes of crushed stone.
- In 2002, California imported 2.2 million tonnes, of which BC imports made up nearly 70 percent (Baja 30 percent), which were shipped to San Francisco, Los Angeles and San Diego.[1]
- California's population of 35.0 million is growing at 500,000 per year and it is forecast that California will require an additional 37 million tonnes/yr. of aggregates by the year 2030 – this is equivalent to 10 times Canada's largest sand and gravel operation at Sechelt (3.1 million tonnes).
- The growth in California's coastal aggregate market (assumed as 10 percent of the state total), after adjusting for declining per capital consumption is shown in Figure ES-2.

[1] http://www.consrv.ca.gov/cgs/minerals/min_prod/non_fuel_2001.pdf

Figure ES-2
Coastal California Aggregate High, Medium and Low Forecast 2005 to 2030



- Aggregate imports to San Francisco are expected to increase significantly over the next few years, largely due to the closure of the 3.6 million tonne/yr. Radum Plant in Alameda County in 2001.
- Many other coastal counties in California are facing aggregate shortages, which will create opportunities for BC and other suppliers.

Pacific Northwest

- Oregon's key market is the Portland area, which is served by barged aggregate from the Columbia River, dredged river sand and inland operations served by rail shuttle.
- Portland area draft limitations tend to preclude the use of deep-sea ships and the economic advantage they may offer.
- Oregon is a relatively small market (3.4 million population and relatively slow growth) – however selected sales of BC aggregates may be possible.
- Washington State is a bigger market than Oregon, centred in the Seattle-Tacoma area in Puget Sound.
- BC has been exporting lime rock and aggregates from Texada Island, Sechelt and Producers Pit in Victoria by barge to Washington State for many decades
- The most significant obstacle to BC producers expanding in the Seattle-Tacoma is the large DuPont aggregate operation (4.1 million tonne-yr) near Tacoma that started in 1997.
- The DuPont operation supplies more than 75 percent of the Seattle-Tacoma market area up to 5 miles west of Puget Sound – 80 percent of the DuPont production is shipped by water -- the round trip to Seattle takes about 24 hours -- during the summer, barging is conducted seven days per week, primarily at night, with only a few hours between shipments.
- Although BC sales will continue in the Puget Sound area, Dupont dominants the current market, which makes it difficult for BC suppliers to compete in this market.
- There are other Pacific Rim markets that BC suppliers have served in the past (e.g. Southeast Alaska, Hawaii), however sales to these markets will likely tend to selective.

Conclusions

- Since late 2002, the US dollar has depreciated by nearly 20 percent — this has reduced the value of US exports in Canadian dollars to BC exporters.
- Obtaining a strategic ship-unloading site in the US is a critical factor in the feasibility of aggregate exports -- existing port facilities tend to be tightly controlled by companies who can dominate material flows.
- Aggregates are a low-valued commodity -- unloading sites for aggregates tend to be scare, since they must compete with other higher-value imports (e.g. containers).
- The availability of good quality coastal aggregate in BC is generally not the constraining factor to the development of new deposits or expansion of existing operations – it is US access, cost and quality as compared to competing local suppliers.
- BC aggregate stakeholders have long argued that the current *Land Act* restrictions that prohibit selling of Crown Land for aggregate extraction discourages the development of the highest and best use of the land.
- In BC the costs of port facilities, including dredging, berthing, and loading equipment, including high-capacity conveyors can constraint development -- land ownership can assist with debt financing.
- The Oregon aggregate rail shuttle operation (Section 6.2) and rail shuttles in other parts of the US suggests that this concept should be investigated to help alleviate aggregate shortages in certain parts of BC.
- The existence of rail lines in BC may provide bulk transportation cost advantages for aggregates, which are not possible by considering only truck hauling alternatives.

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1.0 INTRODUCTION

Contained within this report is an overview of the western North American coastal market for BC construction aggregates. This information may assist the provincial government in considering ways to support First Nations business partnerships and Coastal communities to better position themselves to capture a share of this expanding export market.

1.1 DEPLETION

Historically, aggregate operations were established away from populated areas, but close enough to provide an economic supply. Aggregates are needed close to market, because the product is bulky, low in unit value and expensive to haul. Aggregate is relatively inexpensive at its source, so the cost of transportation is generally the major factor in determining the delivered cost to the consumer. Quarries producing crushed stone tend to operate for longer periods than sand and gravel operations, for example the limestone quarries on Texada Island have operated since the 1890's

In many areas of North America, urban areas are impinging on aggregate operations. Local land use conflicts have emerged as residents object to the blasting, dust and heavy trucks associated with an aggregate operation. In many fast growing jurisdictions, aggregate deposits are being depleted or operating costs are being driven up by regulatory constraints, introduced to appease residents, some of which have encroached on existing aggregate operations.

1.2 TRENDS

The aggregate industry is gradually undergoing a transition as the industry consolidates into fewer, but larger companies. Many of these larger operations are located more distant from populated areas, which is economically feasible through the use of bulk carriers or by rail shuttle operations. The use of ship transport on the Pacific and Atlantic Coasts has allowed suppliers to compete in coastal markets over larger distances.

This has given rise to increasing imports to the US, which is growing in importance in Atlantic Canada and BC. Atlantic Canada has exported aggregates to New York, South Carolina, Georgia, Florida and the Caribbean since the late 1990's.[2] Over the last several years, BC has been shipping aggregates to California. California is a particularly attractive market for BC suppliers because of its large population (35 million/Canada 32 million), it is experiencing rapid coastal urbanization, depleting reserves and regulatory problems facing many in-state producers.

[2] Aggregate & Roadbuilders Magazine (2000), ***Full steam ahead for New Brunswick coastal quarry***. July/August. Pages 20—22. Vulcan Materials, the biggest US producer ships aggregate from the Yucatan Peninsula to Florida and the Gulf Coast.

2.0 BACKGROUND

This section provides some background related to the nature of aggregates, uses, characteristics, users, the structure of the industry and standards.

2.1 NATURAL AGGREGATES

Natural aggregates, which include crushed stone, sand and gravel, are the most abundant natural building material available. Aggregates are used in their natural state or after mechanic processing, such as crushing, washing and sizing. Aggregates consist of clean, uncoated rock particles with the proper size distribution, shape, hardness, strength and chemical properties required for their specific use.

Sand and Gravel

Sand and gravel is typically found in loose, non-cohesive deposits that are produced by various sedimentary processes, including glacial and fluvial processes (e.g., water-related erosion and deposition). Most aggregate deposits were produced during the movement of the glaciers and as flood deposits during glacial recession.

Aggregate deposits are often found near river deltas or wherever water currents slow down allowing the water borne aggregates to naturally settle out. Gravel often is found in deposits as layers or lenses with sand. Sand and gravel deposits are ideal when they contain little or no impurities (e.g. silt, clay, soil). This material are called aggregates because they are usually an 'aggregation' or mixture of unlike sand and stone particles.

Crushed Rock/Stone

While sand and gravel is usually found in its natural state, crushed rock or stone is usually manufactured from blasting and crushing bedrock in a quarry. Aggregate produced from blasting and crushing may cost 25 to 35 percent more than pit-run operations, but the higher cost is warranted for certain applications. In some areas where sand and gravel deposits are scare, crushed stone maybe the only economic source of aggregate.

The best crushed stone is usually made from competent, fine-grained rocks that are not too abrasive or weathered. Crushed stone can be made from a variety of competent rock, including limestone, dolomite, basalt, and trap rock. However, not all crushed rock can be used in cement concretes, due to undesirable chemical reactions.

2.2 MAJOR USES

In general there are three general uses of aggregates: building construction, transportation infrastructure and erosion and sediment control.

Portland Concrete

Aggregate is the chief raw material (by volume) used in Portland cement concrete, which is universally used for construction purposes. A cubic metre of concrete requires about 1.2 tonnes of coarse aggregate, 1.0 tonne of sand and 0.25 tonnes of cement and 0.11 tonnes of water. Therefore, 70 to 85 percent of concrete is composed of aggregates. The use of rounded aggregate in concrete improves the workability of the slurry and its pumpability, where maximum strength concrete is not required.

Building Construction

Natural aggregates are used in the construction and repair of building structures and building projects. Gravel is used directly for foundation support, construction back fill and rounded gravel is used for perimeter drainage. Sand is used for backfill, foundation support for concrete and paving bricks, and as a major component of masonry products, such as mortar and stucco, as well as for landscaping, golf courses and play areas.

Transportation Uses

The largest market for aggregates is for road construction. This includes road base foundations and asphalt and concrete mixtures for highways, parking lots and other pavement uses. Finely crushed stone is used in asphalt, because the sharp rock edges improve bonding strength. About 90 to 95 percent of asphalt mixtures (hot mix asphalt, cold mix and surface treatments) are made of aggregates. Asphalt mixes can accept more fines than concrete, but generally require a narrower particle size distribution. Aggregate is also used for port projects, railway ballast and sand is used for winter road traction. For example, one mile of 4-lane highway requires about 60,000 tonnes of aggregate.[3]

Erosion and Sediment Control

Large aggregate, known as rip-wrap is used for erosion control projects, such piers, dykes, channel linings, and breakwaters. Large gravel and cobbles are used to fill compartmentalized metal containers, which can provide cost-effective material buttressing and erosion control. These aggregate filled galvanized steel containers are also used for channel linings, highway retaining walls, bridge abatements, and beach protection and to protect roads from upslope and downslope slumping. Sand is used to replenish beach sand throughout the world, which is lost to natural beach erosion processes.

Users

In BC, about 60 percent of the commercially produced aggregates are used in public works projects. Since most aggregates are used in public works any changes in costs maybe passed on to the public through higher costs of public service and higher taxes.

[3] Aggregate Producers of BC website. http://www.gravelbc.ca

Integrated Industry

Another important characteristic of the industry is that the companies are often integrated with the aggregate business, with cement companies having subsidiaries in both the ready-mix and aggregate business. This often blurs the distinction between aggregate producers and aggregate users, such as ready mix companies, who maybe owned or affiliated with large multinational cement companies, who own the aggregate operation and also supply cement to the local ready-mix companies. This integrated nature of the industry can create obstacles to new entrants.

2.3 AGGREGATE STANDARDS

The requirements of aggregate buyers can be strict depending upon the particular end-uses and applicable engineering standards that need to be met. These standards are set by such agencies as the Canadian Standards Association (CSA), the BC Ministry of Transportation and Highways, Transport Canada, Master Municipal Construction Documents (MMCD), the American Society for Testing Materials (ASTM) and the State of California Department of Transportation (Caltrans).

Table 2-1 provides some examples of size grading standards for several agencies in Canada and the US.

Table 2-1
Some Typical Sand and Gravel Grading Standards

	CSA Fine Aggregate	CSA Coarse Aggregate Group 1 28-5 mm	Caltrans Road Base 1 ½"	ASTM Road Base 1 ½"	ASTM Concrete Aggregate ¾"
Sieve size mm	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)
40		100			
37.5			87-100	95-100	90-100
28		95-100			
25					
19			45-90	70-80	
14		30-65			
12.6					
10	100	10-30		50-70	20-55
5	95-100	0-10	20-60	35-65	
2.5	80-100	0-5			0-10
1.25	50-90				0-5
0.63	25-65		6-29	12-25	
0.315	10-35				
0.160	2-10				
0.075			0-12	0-8	

Size Distribution

Aggregate has a distribution of sizes, therefore producing a consistent and reliable product is important to buyers. For various applications there are different standards that require strict grading through a series of sieves. Since natural aggregate deposits have a broad range of coarse and fine materials, the production challenge is how to handle rejected materials

Other Properties

There are many other properties that must be achieved for the customer and particular end-use. For example the California Division of Mines specifies, "aggregates used in Portland cement concrete should not contain gypsum, pyrite, zeolite, opal, chalcedony, chert, siliceous shale, volcanic glass, or high-silica volcanic rocks". Gravel with these types of impurities, can produce concrete that may shrink or be reactive to alkalis. The California Department of Transportation has their own specifications for road base, concrete aggregate and asphalt aggregate. Port authorities often have their own specifications.

The aggregate specifications can include the following standards summarized in Table 2-2.[4]

Table 2-2
Typical Aggregate Standards

• Gradations - the percent material in each screen size range must be within specified limits. • Cleanliness - no dirt or clay or undesirable contamination. • Consistent uniform product. • Concrete pumpability – requires smoother gravel.	• Moisture content- typically about 5.0 percent. • Specific gravity and bulk density – typically about 1.9 tonnes/m^3. • Durability of constituents. • Shape of rocks and freshness of particle surfaces. • Reliability of supplier.	• Strength of concrete or mortar produced. • Concrete shrinkage limits met. • Purity- Free from reactive components. • Strength of rocks. • Chemical resistance.

Clean aggregate is required to ensure concrete strength. The aggregate may need to be washed depending on product requirements, which removes fines (dust, clays, fine grains). BC aggregate that has been shipped to California is considered superior to some of the locally available sands and is generally desirable to ensure concrete strength. High quality gravel can sometimes require less cement, to achieve the same concrete strength. Thus the demand for cleaner aggregate can be driven by saving the more costly use of cement for a given grade of concrete.

Aggregate used by ready-mix companies in the production of concrete have stricter tolerances than specifications for construction fill and road bases. Companies may prefer rounded aggregate, because it is easier to pump and finish than concrete with crushed rock. For many jobs the pumpability of the concrete is more important than the strength advantage gained by using fractured aggregate. Ready mix companies may also specify aggregate moisture contents, which under certain conditions can help produce stronger concrete.

[4] Specific gravity, absorption, cleanliness, abrasion loss, coarse durability, water soluble chlorides, deleterious materials, sodium soundness, alkali reactivity, etc.

3.0 EXPORT MARKET DEVELOPMENT

The following describes the development of the California export market and some of the key participants.

3.1 HISTORY

The Canadian Steamship Lines (CSL) has been transporting gypsum from the Baja to Los Angeles, San Francisco, Rainer (in Oregon) and Surrey, BC for many years. The gypsum is used for the manufacturer of drywall (i.e., sheetrock in the US) for the building products industry. CSL transports over 2 million tonnes of gypsum annually from Mexico using self-unloading ships.

In California, a British firm Hanson Aggregates acquired quarries in the San Francisco Bay area from Kaiser Sand & Gravel, the long standing aggregate supplier in the area. Soon after acquiring Kaiser's assets, some of which were being depleted[5], Hanson began looking at barging aggregates from Northern California. Although, several shipments were made in ocean-going barges it did not prove to be economic.

In BC, Construction Aggregates Ltd. was purchased by Lehigh Cement, which included the large operation in Sechelt, which started in 1989. Lehigh determined that the Sechelt operation could also supply the Puget Sound market by barge. Although, the California market was much larger than Puget Sound it was nearly 1,000 miles to the south over rough water and transport in ocean-going barges had so far proved to be uneconomic.

Another participant was the Lafarge Group, who operates a limestone and granite quarry on Texada Island. LaFarge was another company with California projects interested in finding a cost-effective alternative to barging to California. Lafarge is a large multinational company involved in the Los Angeles/Long Beach port development requiring large amounts of construction rock. The Los Angeles/Long Beach port is now the second largest container facility in the world.[6]

3.2 CSL INTERNATIONAL

With the northbound trade in gypsum, CSL was the obvious transportation link because of their empty backhaul. The first shipment of aggregate from BC in a CSL bulk carrier arrived at San Francisco's Pier 94 in 2001. In 2002, CSL imported 800,000 tonnes of sand and gravel into the Bay area and 700,000 tonnes of construction rock into Los Angeles and Long Beach from the Lafarge quarry on Texada Island.[7]

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[5] The 80-year old Radium aggregate operation in Pleasanton in Alameda County (south of Oakland), which closed operations in November 2001. The Radium operation was the largest sand and gravel producer in Northern California, with an annual production rate of 3.6 million tonnes annually. The Pleasanton operation supplied about 25 percent of the aggregate used in the South Bay area. Source: California Department of Conservation (2002) ***California's Non-Fuel Mineral Production 2001***. California Geological Survey, Susan Kohler.

[6] The $576 (US) million Long Beach marine terminal project, which was completed in August 2003 included earthwork placement of 1.15 million m^3 of fill. Source: Port Technology (2002) ***Pier T Marine Terminal Development Port of Long Beach, California.*** Prepared by Steinberg, Ari, Wade Watson & Ken Frederickson.

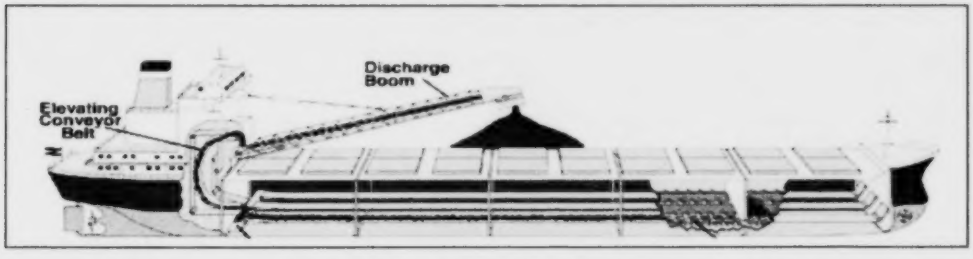
[7] Pacific Maritime Magazine (2003) ***Bulk Imports Meeting Essential West Coast Construction Needs***. July 2003

Figure 3-1 shows the CSL 'Sheila Anne' unloading crushed rock at the Port of Long Beach. The Sheila Anne has since been redeployed transporting coal and aggregate along the east coast of North and South America.

Figure 3-1
CSL Sheila Ann Unloading Aggregate On-Shore in Long Beach, CA

Within the last several years, CSL has commissioned three Panamax "S" class 70,000 dwt bulk carriers with self-discharging unloaders. The CSL self-loading system was originally developed for CSL's Great Lakes cargo ships, which have since been improved by Seabulk Systems Inc. of Vancouver.[8] Shown in Figure 3-2 below, the cargo is brought to the ship's deck by an inclined conveyor and discharged at a rate of 4,000 tonnes per hour by a telescopic 260-ft. boom, either directly onto a stockpile or into a receiving facility.

Figure 3-2
Canadian Steamship Lines Bulk Carrier Self-Loaders



The fast unloading capacity reduces port and demurrage (penalty) costs, which is a critical factor for the efficient transportation of a low-value commodity, such as aggregate.

[8] http://www.seabulk.com/main.html

3.3 PORT DEVELOPMENTS

To accommodate the loading of the CSL bulk carriers, the barge loading facilities at Sechelt were redesigned for deep-sea vessels by extending it out into deeper water and installing a high-speed loading system. This option was selected over dredging due to environmental concerns. The new loading system can load up to 4,000 tonnes per hour (4,500 tonnes per hour at peak).[9]

In California, Hanson entered into a five-year contract with the Port of San Francisco to develop a bulk cargo terminal at Pier 94. In the San Francisco area, Hanson is also offloading BC aggregate at the Port of Redwood[10] (in the south Bay area) for the ready-mix market, once the ships have been partially offloaded at Pier 94 to accommodate the shallower 30-ft channel depth. Hanson is also building a new terminal in the northern San Francisco Bay area (Richmond). When completed, there will be three bulk carrier unloading sites for BC aggregate (San Francisco, Redwood City, Richmond).

CSL's shipping capacity is reported to be about 2.0 million tonnes from Sechelt to Hanson's Bay area market and nearly 1 million tonnes from Texada Island to the Los Angeles/Long Beach area. California imports of aggregates are expected to continue increase.

3.4 TRANSPORT COSTS

The cost of producing aggregate on-site is fairly consistent -- the more significant factor affecting the delivered cost to the user is the cost of transportation. Truck transport costs are in the order of $US 0.20 per tonne-mile, which depends on a number of factors. Truck transport can easily double or triple the cost of aggregate to the customer at haul distance between 30 to 50 miles. Transportation of aggregate by barge or ship offers substantial cost advantages over trucking.

According to the Canadian Steamship Lines, the total shipping costs, using a fully-employed ship including all related port fees is $ 4.75 (US)/tonne plus a fuel escalation charge to San Francisco. Estimated shipping costs are based on the assumption that the trip to San Francisco takes approximately 1 day to load, 3 days en-route, and 1-2 days to unload, 3 days to return for a 8-9 day cycle. It is 960 miles to San Francisco and 1,290 miles to Los Angeles. At 15 knots, 17.25 miles per hour, the sailing times, pilot-to-pilot are 2.4 days to San Francisco and 3.1 days to Los Angeles.

According to Seaspan, barging costs to San Francisco would be about $12.00 (US) per tonne. The barges travel at 7 to 10 knots and the travel time is about 5 days. The unit cost of barging is more than double the cost of using ships. Table 3-1 compares some illustrative average transport costs, which shows that access to low-cost bulk transportation can dramatically reduce costs. It should be noted that a comparison of average costs are specific to the example and should not be used for other cases.

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[9] Aggregate & Roadbuilders Magazine (2000), ***Canada's largest sand and gravel operation ships to California, Hawaii***. Jan.-Feb. Pages 12-13.

[10] The Port of Redwood receive 365,00 tonnes of cement from China to RMC Pacific Material, and 232,00 tones of gypsum to Pabco Gypsum from the Baja during the year ending June 30, 2003. The Port is now receiving shipments of sand from BC, including a 34,000 tonne shipment of BC sand delivered by the 797- foot CSL Nelvana in July 2003. Source: Port of Redwood City Press Release July 14, 2003.

Table 3-1
Illustrative Average Unit Bulk Transport Costs[11]

Mode	Unit Cost	Assumptions
	(¢US per Tonne-Mile)	
Truck	**20.0**	Assumes tandem axle 15-tonne load, $80/hour, 30 mph, 0.1 hr load/unload
Barge	**1.25**	Barge quote $12.00 US per tonne, BC to San Francisco
Ship	**0.52**	Shipping quote 60,000 dwt shipment BC to San Francisco estimated @ $5.00 tonne, 960 miles.

Marine vs. Inland Suppliers

The market area of marine suppliers does not extend very far inland, because typically it is limited by competition from inland suppliers. The cost of bringing aggregate from local inland suppliers limits the maximum shipping distance that coastal suppliers can penetrate inland. Aggregate pricing will usually be a minimum at the marine unloading terminal or at the inland aggregate operation.

In other words, as the water-borne aggregate is hauled inland – delivered cost increases and at the point they approximately equal the cost of hauling from inland suppliers they will define the market 'dividing line' between marine and inland-based suppliers. So as the inland supply cost increases (i.e., through depletion) or as the delivered marine supply costs decrease, so does the effective market area for water-based suppliers (see Figure 4-3 below for this market dividing line for the Lower Mainland).

[11] Estimates from shipping companies. Truck estimates from US Geological Survey (2002) **Sociocultural Dimensions of Supply and Demand for Natural Aggregates.** USGS Open-File Report 02-350, Page 9, and the Sacramento Bee: http://www.sacbee.com/static/live/news/projects/denial/08172003.html#

4.0 BRITISH COLUMBIA

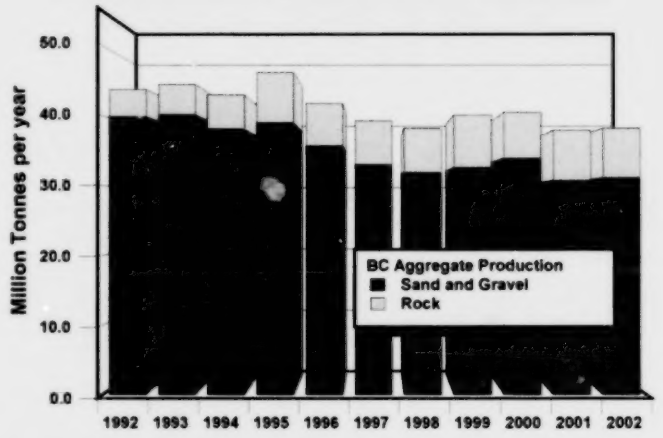
This section discusses the BC consumption of aggregate, forecast domestic use, coastal producers/exporters and opportunities.

4.1 CONSUMPTION

In BC most aggregates are used for public highways, streets, and roads, as well as residential, commercial and institutional construction, airports, ports, railroad and landscape and erosion control works. Similar to other jurisdictions, public works projects uses up to 65 to 70 percent of all aggregates for the construction and maintenance of roads and highways, public utilities (water, stormwater, sewage works) and larger buildings.

Figure 4-1 presents BC sand and gravel and rock production statistics for the period 1992 - 2002, based upon referenced data.[12] In addition to on-going construction projects, big budget highway projects can have a noticeable impact on total provincial aggregate demand. As shown in Figure 4-1, the Vancouver Island Highway Project and the third runway at the Vancouver Airport appears to have a noticeable impact over early 1990's. The construction of the third runway at the Vancouver International Airport consumed at estimated 2.5 million tonnes of aggregate, which was completed in 1996.

Figure 4-1
BC Sand and Gravel and Rock Production: 1992-2002



[12] The Aggregate Producers Association of BC report 50 million tonnes of aggregate consumed in BC annually. This estimate might include an estimate of under-reported or under-reported production, which cannot be confirmed at this time. The data shown here is from Statistics Canada obtained from BC Ministry of Energy and Mines and the ***Canadian Minerals Yearbook 2002***. Chapter 35.2. Reported rock volumes contain small volumes of dimension stone.

Since the mid-1990's BC aggregate consumption has declined to 38 from 41 million tonnes per year, due to BC's low levels of capital investment. Part of this reduction may be attributed to the increased use of recycled asphalt in BC, which effectively reuses the aggregate. New technologies, such as hot-in-place asphalt recycling (HIPAR), repairs and recycles the asphalt in a continuous on-site process, which eliminates removing the material from the site.

The Lower Mainland makes up about half of the BC aggregate market and about 65 percent of the concrete aggregate market.[13] The main source of sand and gravel in the GVRD is from Coquitlam and Abbotsford. Dredged sand from the Fraser River makes up about ¼ of the aggregate supply in the GVRD.[14]

Pricing

The phasing out of aggregate deposits, through depletion or the inability to get new operations approved due to land use concerns, forces suppliers to haul greater distances, which escalates costs.

The BC Ministry of Transportation (MOT) reports that the cost of pit run gravel has doubled since the late-1980s, whereas the general BC price level as increased by about 30 percent over the same period (1989–2002). Since in-pit aggregate costs have not changed markedly, the rising real price of aggregate reflects increasing scarcity as suppliers are forced to access supplies further a field. For example, the large aggregate operation in Victoria (Colwood) is slated for closure. This will further reduce local supply and increase costs.

Forecasting BC aggregate use depends upon a number of underlying factors, such as general population growth. However, large public infrastructure projects are more difficult to predict, because they tend to occur when public funding is made available.

Future Requirements

Over the early 1990's, while large construction projects were proceeding, aggregate use in BC was relatively high at 11.9 tonnes per capita. Since about 1995, aggregate use has declined to about 9.6 tonnes per capita. Over the entire 1992 to 2002 period, average per capita consumption has been about 10.7 tonnes per capita.[15] It should also be noted that as communities become more densely urbanized, aggregate usage per resident decreases.

Figure 4-2 presents a range of coastal aggregate forecasts over the 2005 to 2030 period, based upon a high, medium and low growth rate. The middle line is assumed to be the "most likely" forecast, reflecting the Statistics Canada data over the 1992 to 2002 period.

The 'most likely' forecast of Coastal aggregate demand assumes requirements will increase from 22.8 million tonnes (50 percent of the BC total) in 2005 to 30.2 million tonnes in 2030, which represents a 1.0 percent annual rate of growth. This suggests that by 2030 the coastal requirements for aggregate

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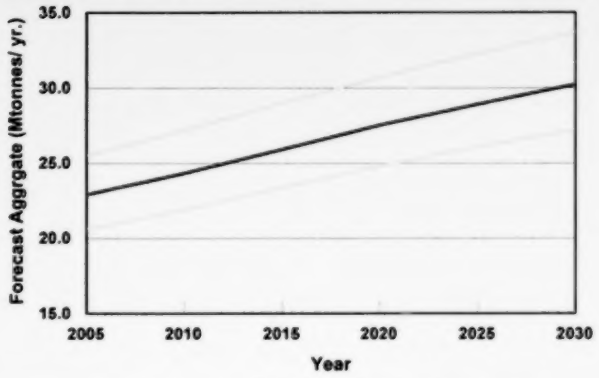
[13] BC Employment & Investment, Levelton Engineering Ltd., ***Lower Mainland Aggregates Demand Study*** June 19, 1996 www.em.gov.bc.ca/dl/mog/leveltonreport.pdf.

[14] Memo to G. Bridges from Brian Weeks, P.Eng, President of the Aggregate Producers Association of BC. October 24, 2002.

[15] Most Canadian jurisdiction use about 10 to 16 tonnes per capita per year. Source BC Ministry of Energy and Mines (2001) ***Managing Aggregate, Cornerstone of the Economy Report of the Aggregate Advisory Panel,*** Page 2.

will increase by over 7.0 million tonnes, which is more than twice the current output of BC's largest operation (Sechelt 3.1 million tonnes/yr.)

Figure 4-2
Coastal Aggregate Requirements High, Medium and Low Forecast 2005 to 2030



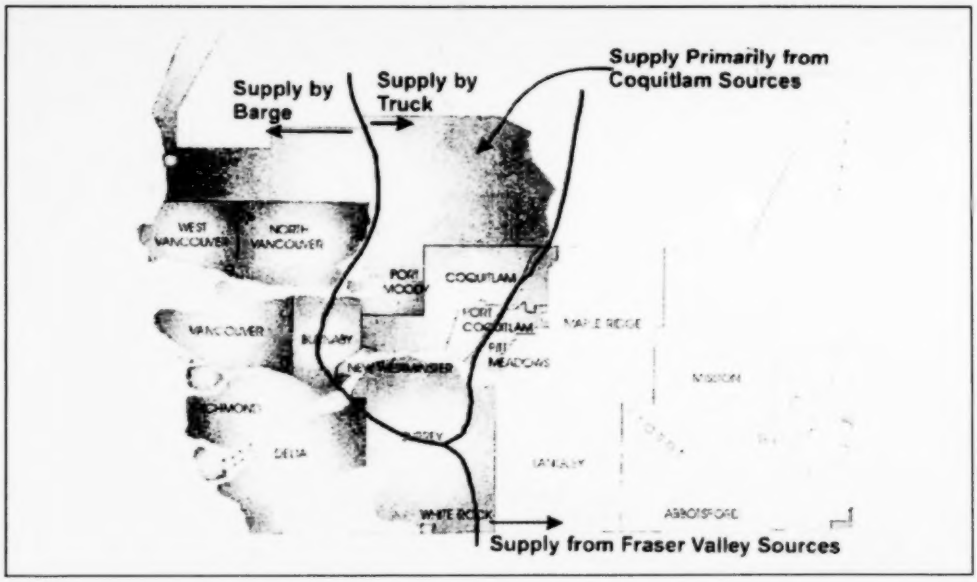
Coastal BC Market

The Sunshine Coast deposits (reviewed below) generally supply the western part of the GVRD, which is shipped by barge and then by truck. The maximum truck haul distance for barged aggregate ranges up to approximately 40 km. as shown in Figure 4-3.[16] This 'market area' would include most of the GVRD and most of the other communities along the BC Coast. Due to port, unloading and other constraints, we have assumed that the coastal market represents approximately 45 to 50 percent of the total BC market.

There are several major public works projects in the Lower Mainland, that are continuing over the decade that are increasing aggregate demand, such the Highway 10 & 11 upgrade, the Gateway Projects leading up to 2010. The Gateway projects include the South and North Fraser perimeter road upgrades and the twinning of the Port Mann Bridges, Highway 1 improvements and another Fraser River Crossing at Barnston Island. Coastal aggregate suppliers will supply some of the western portions of these projects as illustrated below.

[16] Levelton Engineering Ltd. (1996) *Lower Mainland Aggregates Demand Study Volume I Aggregate Supply and Consumption*, Figure 7 Lower Mainland Market Areas

Figure 4-3
Lower Mainland Marine Supplier Market Area[17]



4.2 COASTAL PRODUCERS/EXPORTERS

In BC, there are over 900 permitted commercial aggregate operations, in addition to thousands of small reserves held by the BC Ministry of Transportation.[18] The largest aggregate producers in BC are owned by large integrated cement companies operating on private land.

The primary existing quarries are on the Sunshine Coast (Sechelt, Egmont and Jervis Inlet) and three on Texada Island.

Construction Aggregates (Sechelt)

Lehigh Cement's subsidiary Construction Aggregates Ltd. (CAL) has the large Sechelt aggregate operation located 48 km. north of Vancouver. This operation is Canada's largest sand and gravel operation at 3.05 million tonnes in 2001.[19] The operation began in 1989. The pit has a capacity of 30,000 tonnes per day.[20] At 250 days per year the operation could supply 7.5 million tonnes per year or more with expanded output. In 1993 production peaked at 5.6 million tonnes, when the pit supplied the Vancouver International Airport third runway expansion.[21]

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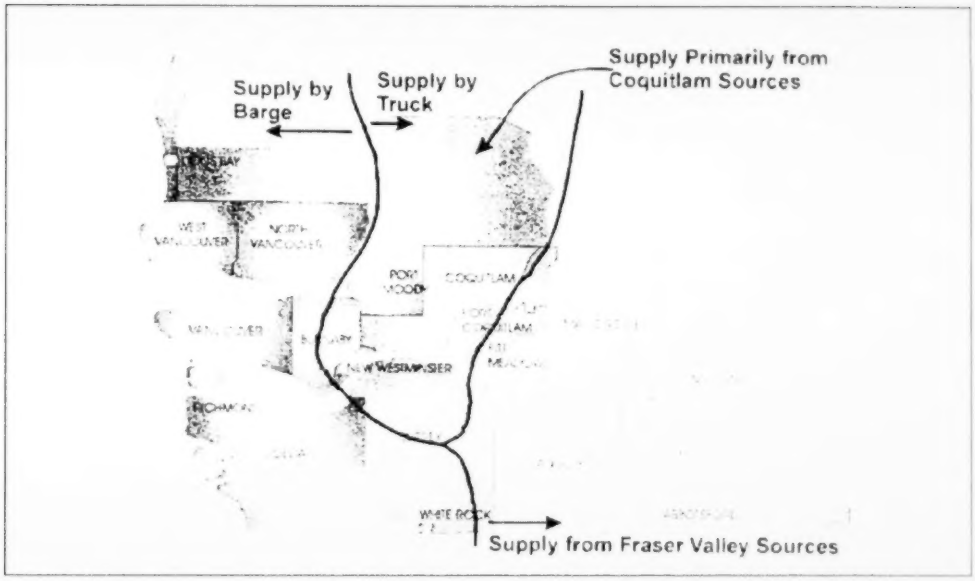
[17] Levelton Engineering Ltd., ***Lower Mainland Aggregates Demand Study*** June 19, 1996. Figure 7. www.em.gov.bc.ca/dl/mog/leveltonreport.pdf
[18] BC Government (2001) ***Managing Aggregate, Cornerstone of the Economy***, Page 1.
[19] Information on coastal producers from various sources, including: Aggregate & Roadbuilders *Canada's Top 10 Sand and Gravel Plants* (1996) and subsequent years.
[20] 37th Forum on the Geology of Industrials Minerals, May 23, 2001. Trip 2: Construction Aggregates Site Guide
[21] Aggregates & Roadbuilding (1998) ***Sechelt upgrades for high-tonnage aggregate production***. May/June. Pages 18 – 21.

Figure 4-3
Lower Mainland Marine Supplier Market Area[17]



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[17] Levelton Engineering Ltd., ***Lower Mainland Aggregates Demand Study*** June 19, 1996. Figure 7. www.em.gov.bc.ca/dl/mog/leveltonreport.pdf
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[19] Information on coastal producers from various sources, including: Aggregate & Roadbuilders *Canada's Top 10 Sand and Gravel Plants* (1996) and subsequent years.
[20] 37th Forum on the Geology of Industrials Minerals, May 23, 2001. Trip 2: Construction Aggregates Site Guide
[21] Aggregates & Roadbuilding (1998) ***Sechelt upgrades for high-tonnage aggregate production***. May/June. Pages 18 – 21.

The Sechelt plant produces 12 standard and over 40 blended products including washed aggregates, crushed rock, road base, asphalt materials, and various specialty sands. Most production is shipped by barge, with the average barge load of about 4,700 tonnes. Barging is handled by CAL's Marine Division, which operates a fleet of five tugs and 15 barges.

Figure 4-4
High Capacity Ship Loader, Sechelt, BC

The Sechelt plant's primary market is the Lower Mainland, but it also ships aggregates to Tacoma, Seattle and since 2001 California. What sets the operation apart is its 4,000-tonnes/hr. ship loader, shown in Figure 4-4.

The Sechelt plant markets its aggregates in the US through Hanson West Materials. Hanson is well positioned in California and has a cement plant in San Francisco and terminals in the Ports of San Francisco (Pier 94), Richmond (in the Bay area) and Long Beach. The delivered price of concrete aggregate to the Port of San Francisco to the Port of Richmond (San Francisco Bay) was $10.00/ton in 2003. No other BC aggregate operation has been able to match the quality, price, and access to US terminals as the Sechelt operation.

The 404-hectare property contains a current estimated reserve life of 250 million tonnes, which will allow 50 yrs. of operation at current production levels.

Producers Pit (Victoria)

In the Victoria area, Producers Pit has operated since 1919. Once one of Canada's largest sand and gravel operations, the operation in Colwood produced 1.5 million tonnes of aggregates in 2002, down from its peak of 4.0 million tonnes. Lehigh used to ship sand (300,000 tons) to Cadman ready-mix, a subsidiary of Lehigh Cement, in Seattle. Most of the production is shipped by barge to the Lower Mainland, with the remainder trucked to Vancouver Island customers. Producers Pit will be phased out over the next year or two and will be redeveloped as the Royal Bay residential development.

Lafarge Canada (Earle Creek)

In addition to its Texada Island operation, Lafarge Canada operates its Earle Creek operation, near Egmont on the Sechelt Peninsula. In 2002 the Earl Creek operation produced 1.3 million tonnes. The operation started in 1974, by Argus Aggregates until 1976, when Lafarge took over operations. Earle Creek is only accessible by tidewater and ships its product in 3,600 to 7,500 tonne barge shipments to the Lower Mainland.

Special orders have been shipped from Earl Creek to Alaska and Washington State. In 2002, Lafarge barged gravel to Texada Island and sent two 26,000 tonne shipments by CSL to Redwood City, which is south of San Francisco. The facility does not have ship-loading facilities. The 343-hectare property contains over 50.0 million tonnes. At current production levels, the Earle Creek operation has over 30-years of reserve life.

Jack Cewe (Jarvis Inlet)

The Jack Cewe Jervis Inlet aggregate operation is located in Jervis Inlet, north of Lafarge Canada's Earle Creek operation, shown in Figure 4-5.[22] This operation is serviced by barge only. Jack Cewe has another operations in Coquitlam, the Pipeline Road Pit, which produced 1.3 million tonnes in 2002, which serves the Lower Mainland.

Figure 4-5
Jack Cewe Jervis Inlet Operation

Lafarge Canada (Gillies Bay)

Texada Island is 32 miles long and six miles wide at its widest point and is the largest of the Gulf Islands. Texada is located approximately 50 miles north of Vancouver in the Strait of Georgia. The top 1/3rd of the Island has rich limestone deposits that have been quarried since the 1890's. Although, some limestone is used for construction, most lime rock is used for chemical purposes and therefore commands a higher price than construction aggregates.

Figure 4-6
Texada Island Limestone Quarry

Lafarge Canada operates its Texada Quarrying operation north of Gillies Bay on the west side of Texada Island. This operation is Canada's 4th largest quarry based on 2001 production. The operation has been in production since 1956 through previous companies (e.g. Holman West Materials).[23] LaFarge has a 1,000-tonne/hr. ship loader and they presently ship lime rock by barge to their cement plants in Richmond, BC and Seattle and rock by ship to California projects.

Ashgrove Cement (Blubber Bay)

Ash Grove Cement West Inc. at Blubber Bay is Canada's 7th largest quarry based on 2001 production at 3.38 million tonnes. The Blubber Bay Quarry has been worked continuously since 1907.[24] The Company sells aggregates, agricultural limestone and also limestone rock to their cement plant in Seattle and chemical grade limestone to their Rivergate lime plant in Portland, as well as aggregates and chemical grade limestone in BC. Most of their output is shipped to the US. Finely crushed limestone is produced at their Portland lime plant for the agricultural and roofing markets. Chemical grade lime rock is not usually used for construction or concrete aggregate because it is higher priced. Both the Gillies Bay and Blubber Bay operations have excess capacity and are actively marketing in BC and the US.

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[22] http://www.cewe.com/aggregates.htm
[23] P.M. Styles (1995) ***Holnam West Materials Ltd. Limestone Quarry Texada Island.*** Presentation at Focus on BC Industrial Materials October 19, 1995
[24] Aggregates & Roadbuilding (1997) ***New era for BC coastal quarry***. December 1997. Pages 13 –14.

Imperial Limestone (Vanada)

Imperial Limestone Ltd. has a 220,000-tonne/yr. limestone quarry at Vananda, and has operated on Texada Island since the 1950's. Imperial Limestone Corp. is based in Seattle and ships to lime plants in Langley and the Port of Tacoma.

In most cases, suppliers have capacity to supply more aggregate than the market currently requires.

Table 4-1
Major Coastal BC Aggregate Producers

Operation	Location	Primary Product	Production 2001	Estimated Life
OPERATING			('000 tonnes/yr.)	
Construction Aggregates	Sechelt	Sand & Gravel, Crushed Rock	3,005	50-yrs.
Construction Aggregates (Colwood)	Victoria	Sand & Gravel	1,510	2-yrs.
Lafarge Canada (Earle Creek)	Egmont	Sand & Gravel	1,300	50 M tonnes
Jack Cewe, (Jervis Inlet)	Sunshine Coast	Sand & Gravel	N/A	
Lafarge Canada (Gilles Bay)	Texada Island	Limestone	3,500	
Ash Grove Cement (Blubber Bay)	Texada Island	Limestone	3,380	
Imperial Limestone (Vananda)	Texada Island	Limestone	220	
PROPOSED			Proposed	
Eagle Rock Materials Ltd	Alberni Inlet	Crushed granite	6,000	650 M tonnes
Orca Sand and Gravel Project	Port McNeill	Sand & Gravel	6,000	212 M tonnes
Bella Coola Rock Corp.	Bella Coola	Crushed rock	N/A-	30 M tonnes
Swamp Point.	Portland Canal	N/A	N/A-	N/A

4.3 COASTAL OPPORTUNITIES

Jack Cewe (Jervis Inlet)

Jack Cewe Ltd. has proposed to expand their existing barge loading system to accommodate self-unloading ships (Figure 4-7). The water depth at the present dock is 20 feet and they are planning to extend the dock to deeper water. The cost of the new loading system was estimated to be $6.0 million.

Figure 4-7
Jervis Inlet Barge Loadout

The Jervis Inlet operation exported two 10,000-ton barges towed in tandem to the Port of Redwood City, south of San Francisco, but proved to be uneconomic. More recently barges have been taken to Lafarge's shiploading system on Texada Island. However, this resulted in adverse quality impacts.

One of the problems with the Jervis Inlet operation it has a high proportion of rock. Exports from Jervis Inlet would require significant crushing to match the desired sand and rock output. Round rock and sand are preferred in the San Francisco concrete market. The San Francisco market would not likely pay the required price for the crushed rock. Crushed rock is used mainly for asphalt and lower priced local basalt rock available in the San Francisco Bay area is more competitive.

Campbell River and Courtenay Area

The existing dock at Middle Point near Campbell River could be a potential export point for sand, gravel and crushed rock from the Campbell River and Courtenay area.[25] Transport Canada plans to transfer the dock to the District of Campbell River and the Hamatla Treaty Society. To enable bulk carrier exports dredging is required, which could allow ships to load at this facility. Transport Canada's wharfage charge is $0.52/tonne for barge-loaded aggregates.

Figure 4-8
Middle Point Terminal, Campbell River

The BC Transportation Financing Authority owns the 48-inch wide loading conveyor at Middle Point, which is leased to Quinsam Coal Ltd. There is a $2.00 per tonne fee for coal transport using the facilities, which may be cost prohibitive for aggregates. The Ministry of Transportation considers the Middle Point terminal suitable only for barges. Although CSL and other ship owners have indicated they would be willing to load at the Middle Point terminal some modifications would be required.[26]

There is also private dock near central Campbell River owned and operated by Breakwater Resources Ltd., Toronto, (formerly Boliden Westmin Canada Limited), used to load copper and zinc concentrate. Although, there is space near the 500-tonne/hr. ship loader for aggregate storage, the Campbell River Band owns the site and plans to convert it to a cruise ship terminal. Furthermore, Breakwater Resources has concern over contamination of their concentrates.

There are other aggregate supplies in the general area, however, with the truck haul distance, royalties and loading fees, Campbell River aggregates are generally uncompetitive.

Port McNeill (Orca Sand and Gravel)

The Orca Sand and Gravel project represents a partnership with Polaris Minerals of Vancouver and the Kwakiutl and Namgis First Nations, who are proposing to develop a large 4 to 6 million tonnes per year sand and gravel operation near Port McNeill.[27] This is a similar arrangement as the Eagle Rock Materials Ltd., partnership with the Hupacasath and Ucluelet First Nation with their proposed crushed rock project in Alberni Inlet. The proposed Orca Sand and Gravel project will occupy 240 hectares and they intend to export to California.

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[25] http://www.seabulk.com/middle.html
[26] Seabulk Systems Ltd., Richmond, BC http://www.seabulk.com/projects.html
[27] Polaris Minerals (2003) ***The Orca Sand & Gravel Project: Project Description*** *Submitted to the BC Assessment Office.*

Port Hardy

There is an existing 500-tonne/hr. ship loader at the former BHP Minerals copper mine site on Quatsino Sound west of Port Hardy. A private company has proposed to use this loader for aggregate loading. There is a former iron ore ship-loading site at Beaver Cove near Port McNeil. This site has existing road access and deep enough water close to shore, but the dock and loading equipment have been removed.

Gold River

The former Bowater pulp mill dock at Gold River maybe available for loading crushed rock. Although the dock is not quite long enough to conveniently load self-unloading ships, a loading conveyor system could be devised. There is a deposit of basalt rock on the property, suitable for fill or asphalt near the dock that could be crushed and screened for tidewater shipment.

Port Alice

There is a lime rock quarry and barge-loading terminal at Port Alice as well as a silica quarry in the area. Either or both of these operations may be considered for export sales.

Port Alberni (Eagle Rock)

Eagle Rock Materials Ltd., a partnership of the Hupacasath First Nation, the Ucluelet First Nation and Polaris Minerals is developing a granite quarry in Alberni Inlet near Port Alberni.[28] The Eagle Rock Quarry is expected to ship up to six million tonnes of aggregate per year to California. The project received its Mine Permit and Environmental Assessment Certificate in 2003. The proposal includes the development of new receiving and crushed rock distribution terminals in California. Eagle Rock Materials Ltd. is 70 percent owned by the Polaris Mineral Corporation of Vancouver.

Ocean Falls

Ocean Falls Economic Development Committee has considered proposals for gravel exports. There is a loading dock at this site. However, gravel would need to be trucked some distance to the dock and a ship-loading conveyor would need to be installed.

Bella Coola (BC Rock)

There was a proposal in 1999 to build an aggregate storage system and ship loader at Bella Coola at a cost of about $16.7 million.[29] A quarry permit was issued in 1999 for 245,000 tonnes per year of aggregate removal. The port site is west of Bella Coola at Sutlej Point, adjacent to the existing Bella Coola harbour breakwater and ferry terminal. The project included a gravel pit 27 km east of the ship loader at the Nutsatsum River up the Bella Coola Valley.

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[28] Quarry News (Nov. 2004). http://www.quarrynews.com/nov03/eagle.html.
[29] Villholth Jensen & Associates Ltd., North Vancouver, August, 1999.

Kitimat

Eurocan Pulp Division of West Fraser Timber Ltd. has an idle wood chip loading system in the Port of Kitimat that could be used for loading aggregate from two existing nearby gravel pits. The terminal is privately owned and operated by West Fraser Timber Co. Ltd.

There have been previous attempts to establish a public port beside the Eurocan terminal. If the access road were public or if there was a minimal charge to use this road, it may be economic to load gravel at the terminal.

Prince Rupert and Terrace

Ridley Terminals has ample capacity for unloading, storing and loading gravel using their high capacity ship loaders. One advantage at Prince Rupert is that the maximum ship size for the San Francisco market, 60,000 tonnes could easily be loaded, however there is no readily available aggregate in the Prince Rupert area.

A company in Prince Rupert has been planning a new aggregate development along the CN Rail line near Terrace about 150 miles from tidewater. CN Rail has offered to transport aggregate to the Prince Rupert marine terminal in unit trains. A new rail spur to the gravel deposit would be required.

Stewart

Stewart is located at the mouth of the Bear River at the head of the Portland Canal. The Bear River increases the size of its delta by about 300,000 m^3 per year, which pushes the delta forward about 12 centimeter/yr. This continual deposition requires that the level of Bear River be reduced by 2 meters to prevent flooding.[30] Aggregate must be removed from the 5 km of riverbank from the barge terminal to 500 meters upstream of the highway bridge.

Stewart Bulk Terminals Ltd. has a ship loader in the Port of Stewart that could be used for loading aggregate from the Bear River. The facility can accommodate ships up to 45,000 dwt and can loaded at a rate of up to 750 tons per hour. The dredged sand and gravel along the Bear River has been proposed for use in expanding the existing nearby barge terminal. The gravel is quite coarse and would need to be crushed to the correct size specifications. However most coastal concrete manufacturers (except for San Diego) prefer round rather than crushed crock.

If gravel processing was developed it could be located along the Bear River close the existing aggregate areas. The operation would likely require a 1.3 km long bypass road along the north side of town.[31] Another constraint is that the operating period may be restricted by the DFO for the extraction of aggregate from the Bear River during December, January, February and March and shipments could only be made during the summer and fall. It is also reported that a $0.50/tonne

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[30] Lauga & Associates Consulting Ltd., "Stewart Port Business Development Plan", BC Ministry of Small Business, Tourism & Culture, Victoria, April, 1995.
[31] Williams, Gary "Port of Stewart Environmental Management Plan, Department of Fisheries & Oceans, Smithers, BC, Dec. 20, 1995.

provincial royalty is payable for removal of these aggregate deposits. Another potential supplier is Swamp Point Aggregates located further down the Portland Canal.

5.0 CALIFORNIA

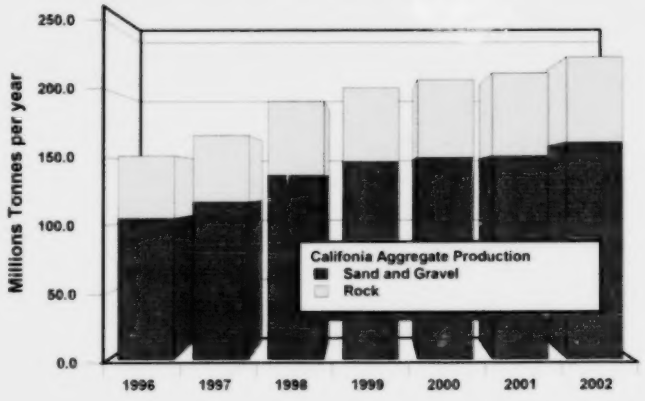
California is the most important future market for BC aggregates as local reserves are being depleted and in-state coastal producers are being displaced by rising land values and difficulties in obtaining approvals for new sites.

5.1 CONSUMPTION

Construction sand and gravel was California's leading industrial mineral with a total value of $1.2 billion (US) in 2002. California produced a total of 223 million tonnes of aggregates, including 159 million tonnes of sand and gravel and 64 million tonnes of crushed stone.[32] Vulcan Material is California's leading producer, who is dominant in Southern California.

California's imports of aggregate from BC and Mexico almost tripled in 2002 over 2001. California imported 2.2 million tonnes in 2002, as compared to 800,000 tonnes in 2001. BC imports comprised nearly 70 percent of total imports, which are shipped to San Francisco, Los Angeles and San Diego.[33] Sand and gravel imports to California represent 1.0 percent of the state's consumption, but is growing rapidly.

Figure 5-1
California Aggregate Production: 1998-2001



The best BC export market is the San Francisco Bay area, which consumes about 12 million tonnes of crushed rock and 23 million tonnes sand and gravel annually. Although, the Los Angeles and San Diego market consumes almost four times more (nearly 90,000 tonnes/yr.) prices are generally lower than in the San Francisco Bay area.

[32] California Department of Conservation (2003) ***California Non-Fuel Minerals 2002***. California Geological Survey, Susan Kohler.
[33] http://www.consrv.ca.gov/cgs/minerals/min_prod/non_fuel_2001.pdf

Table 5-1
Major Coastal California Sand and Gavel Markets

Market	Volume	Price	Value
	(tonnes/yr.)	($US/tonne)	($US M/yr.)
San Francisco Bay Area	23,000	8.25	190
Los Angeles/ San Diego Area	88,000	6.00	530

Aggregate Using Projects

The San Francisco International Airport is assessing construction of new runways as a way to end chronic bad-weather delays and to accommodate a new generation of larger jets and cut noise complaints from surrounding communities. This project would represent the largest San Francisco Bay area fill project to date requiring filling up to 1,000 acres.

This project was planned for completion by 2005, but was delayed due to the September 11, 2001 attack on the World Trade Center. An international design competition was held and five project teams were selected to refine their concepts. The project is environmentally controversial and one innovative proposal is to construct a floating runway, which would reduce fill requirements.

Another major project is the replacement of the East Span of the San Francisco-Oakland Bridge. In 1989 the Loma Preita earthquake collapsed a section of the east span of the Bridge. Although the bridge was repaired it was decided after lengthy study to replace the east span to meet earthquake standards. The new bridge will be quite striking in that it will have two side-by-side decks suspended by a single tall 525-foot high suspension tower. Construction of the project started in January 2002 and BC aggregates are now being used for this and other Bay area projects.

5.2 OUTLOOK

In California, like other jurisdictions aggregate consumption per capita is correlated to population and density. The general pattern is that the higher the population density the lower is the per capital consumption of aggregates.

According to the US Geological Survey, the US per capita aggregate consumption rate is reported to be 9.7 tonnes per capita.[34] California has a population of 35 million and a relatively high population density of 217 persons/mile^2, which is higher than the US average of 80 persons/mile^2.[35] This suggests that California would consume less aggregate per capita than the US average. California's aggregate consumption per capita is 6.1 tonnes per capita, which is less than the US average of 9.7 tonnes per capita.

California has a large population of 35.0 million people, which is growing at about 500,000 people per year (1.4 percent per annum). After adjusting for increased population density, it is forecast that California will require an additional 36 million tonnes/yr. by the year 2030.[36] By 2030

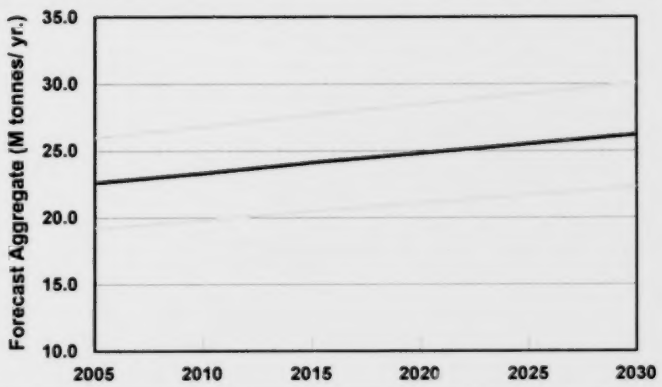
[34] USGS (2002) **Socioeconomic Dimensions of Aggregate of Supply and Demand**. http://pubs.usgs.gov/of/2002/of02-350/aggregate.pdf
[35] http://quickfacts.census.gov/qfd/states/06000.html
[36] Based on a comparison of state population densities and per capita consumption levels (higher density lower per capita

California's total consumption is estimated to be 262 million tonnes compared to 225 million tonnes estimated from 2005.

Coastal Aggregate Forecast

As explained above only a portion of a jurisdiction's total aggregate requirements maybe supplied from coastal suppliers, recognizing that most of California's population lives relatively close to the coast. Coastal suppliers could potentially replace reserve depletions as well as supply new coastal demand. Arbitrary assuming that 10 percent of the California market could be accessed by Coastal aggregates suppliers, Figure 5-2 indicates the size of the potential market based on these assumptions. The size of the export market is ultimately dependant of the delivered price and quality.

Figure 5-2
Coastal California Aggregate High, Medium and Low Forecast 2005 to 2030



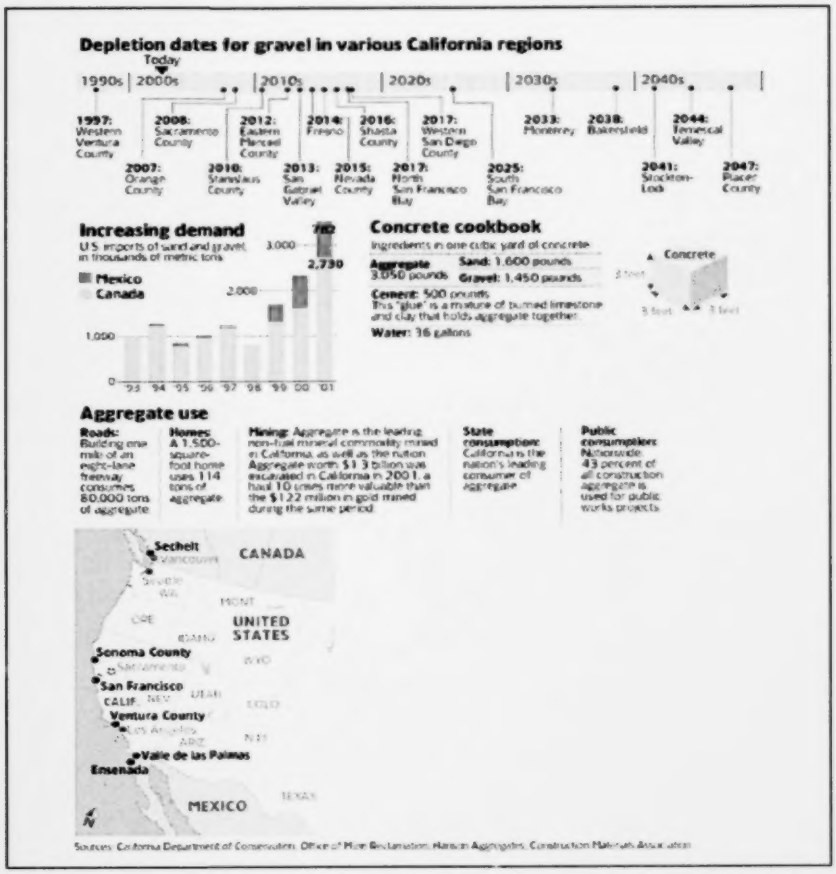
Reserve Depletions

California is depleting its existing reserves and as urbanization continues many of the best deposits will never be developed due to social, environmental or economic factors. In many cases the land is more valuable for housing and the aggregate reserves will never be developed. The Sacramento Bee newspaper ran an article covering California's aggregate industry in 2003, which included estimates of various depletion dates by California county, shown in Figure 5-3.

Approval of new aggregate reserves in California is expensive and time-consuming. As fewer of the smaller companies are able to afford the escalating development costs, the number of closures is exceeding new approvals. In the San Francisco area the number of aggregate reserves decreased by nearly a third over the 1980s and 1990s -- from 32 to 23 and from 81 to 56 in Southern California.

using states), it was assumed that California's per capital consumption of aggregates would decrease from 6.1 tonnes per capita to 5.0 tonnes per capital by the year 2030. Based upon USGS Mineral Industry data by state and population Census QuickFacts by state.

Figure 5-3
Depletion Dates of California Aggregates By County


Depletion dates for gravel in various California regions
Today
1990s
2000s
2010s
2020s
2030s
2040s
1997: Western Ventura County
2007: Orange County
2008: Sacramento County
2010: Stanislaus County
2012: Eastern Merced County
2013: San Gabriel Valley
2014: Fresno
2015: Nevada County
2016: Shasta County
2017: North San Francisco Bay
2017: Western San Diego County
2025: South San Francisco Bay
2033: Monterey
2038: Bakersfield
2041: Stockton-Lodi
2044: Temescal Valley
2047: Placer County
Increasing demand
U.S. imports of sand and gravel, in thousands of metric tons
Mexico
Canada
3,000
2,000
1,000
0
'93 '94 '95 '96 '97 '98 '99 '00 '01
2,730
Concrete cookbook
Ingredients in one cubic yard of concrete
Aggregate 3,050 pounds
Sand: 1,600 pounds
Gravel: 1,450 pounds
Cement: 500 pounds
This "glue" is a mixture of burned limestone and clay that holds aggregate together.
Water: 36 gallons
Concrete
Aggregate use
Roads: Building one mile of an eight-lane freeway consumes 80,000 tons of aggregate.
Homes: A 1,500-square-foot home uses 114 tons of aggregate.
Mining: Aggregate is the leading non-fuel mineral commodity mined in California, as well as the nation. Aggregate worth $1.3 billion was excavated in California in 2001, a haul 10 times more valuable than the $122 million in gold mined during the same period.
State consumption: California is the nation's leading consumer of aggregate.
Public consumption: Nationwide, 43 percent of all construction aggregate is used for public works projects.
Sechelt
CANADA
UNITED STATES
Sonoma County
San Francisco
Ventura County
Valle de las Palmas
Ensenada
MEXICO
Sources: California Department of Conservation, Office of Mine Reclamation; Hanson Aggregates; Construction Materials Association

Ventura County, north of Los Angeles, depleted its aggregate reserves in 1997. Although Ventura County has good deposits, none have been approved and aggregates are now hauled 75-miles from inland deposits near Palmdale. Hauling aggregate long distances adds highway maintenance costs, degrades air quality and increases costs.

In the San Francisco area, one of California's biggest quarries, the Radum pit closed in 2001, after 80 years of operation. There area plentiful reserves of aggregates nearby, but they are covered by houses. According to the schedule of depletions, the counties (and populations) that will be short of aggregates are as follows:

- By 2010: Western Ventura, Orange County and Sacramento County (3.2 million)
- By 2020: North San Francisco Bay (2.2 million) and Western San Diego (1.5 million).
- By 2030: South San Francisco Bay (2.9 million)
- By 2040: Monterey County and Stockton (0.4 million)

These areas had an estimated population of 10.2 million people in 2000, which represents about 1/3rd of California's population.

5.3 NORTHERN CALIFORNIA

In the San Francisco Bay area there are essentially two main companies with marine terminals suitable for receiving bulk carrier shipments -- Hanson Aggregates West and RMC Industries. Although, important in the area, the Lehigh and Cal Cement terminals are relatively distant from the San Francisco Bay.

Hanson Aggregates West

Hanson Aggregates West is an UK-based company, which is a major player and has BC supply arrangements with Construction Aggregates in Sechelt. Hanson has aggregate operations, asphalt and cement plants in the Bay area. Hanson took over Kaiser Sand & Gravel and Kaiser Cement (active since the 1920's). Hanson operates a cement plant at Cupertino south west of San Francisco and has four asphalt plants in the area and is involved in sand dredging. Hanson unloads BC aggregates at Pier 94 in the Port of San Francisco.

In addition to its Bay area operations, Hanson and its affiliates operate plants in Amador, Los Angeles, Riverside, San Bernardino, San Diego, Sonoma and Ventura counties (see Figure 5-4). Hanson is the 3rd leading aggregate producer in the US, behind Vulcan materials (#1) and Martin Marietta Materials (#2).[37] In 1998, Hanson produced 40 million tonnes of aggregates, 1.5 million tonnes of cement, 2.3 million tonnes of ready mix concrete and 2.3 million tonnes hot mix asphalt.

RMC Industries

Another UK-based company, RMC Industries is an important company in the Bay area. RMC bought Lone Star Cement in 1995 and the Davenport Cement plant in Santa Cruz and has over 10 ready mix plants around the Bay area. RMC has aggregate operations, harbor sand distribution terminals, and asphalt plants in the Bay area. RMC has nine sand and gravel operations, one crushed rock quarry, 2 tidewater harbor sand distribution terminals, 12 ready mix plants and 2 asphalt plants in the Bay area.

RMC Industries purchase more than 4.5 million tonnes of aggregate annually and were the first company to import aggregate from BC by barge from LaFarge on Texada Island. RMC also imports cement from China. They have facilities in Alameda, Fresno, Monterey, Placer, Sacramento, San Joaquin, Santa Cruz and Tulare counties.

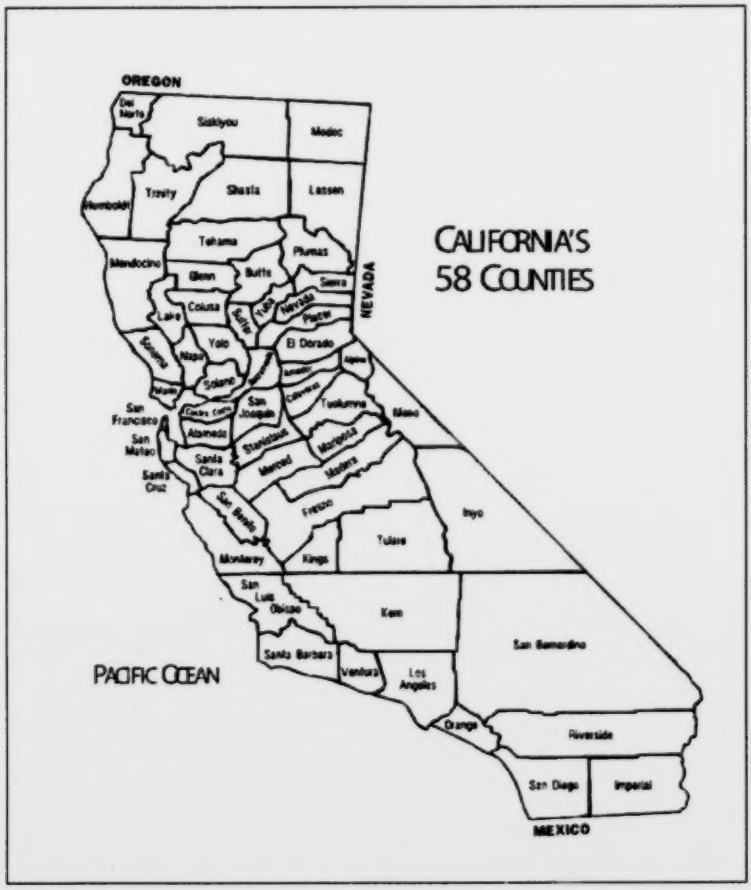
Other Companies

There are many other companies in the Bay area, however most purchase their aggregates from other suppliers, including Hanson and other local suppliers. Another notable company is Cemex Industries (based in Mexico), which is a fast growing company and is one of the world's three largest cement manufacturers. Most of Cemex revenues are earned from the manufacturer of

[37] USGS (2003) ***Mineral Industry Surveys for 2002***, page 1 &2.

cement, but it also operates ready-mix plants, which purchase aggregates. Cemex has facilities in Richmond in the Bay area, and in Riverside and San Bernardino counties in Southern California.

Figure 5-4
California Counties



San Francisco Bay Sand

About a third of the sand used in the Bay area is obtained from dredging the San Francisco Bay. The dredged sand is relatively fine and must be blended with other coarser sands for the manufacturer of concrete. Some of the best coarse sand comes from Sechelt. This sand often contains 5 percent material between 10 mm and 5 mm, which complements the finer dredged sand.[38] The other major source of sand that Hansen produces in the Baja is too fine to be used directly for concrete. Although, Hanson adds coarser sand manufactured from crushed rock, the Baja sand sometimes fails to meet concrete standards.

[38] Sand meeting the Caltrans spec appears to be fine if 100 percent is less than 5 mm.

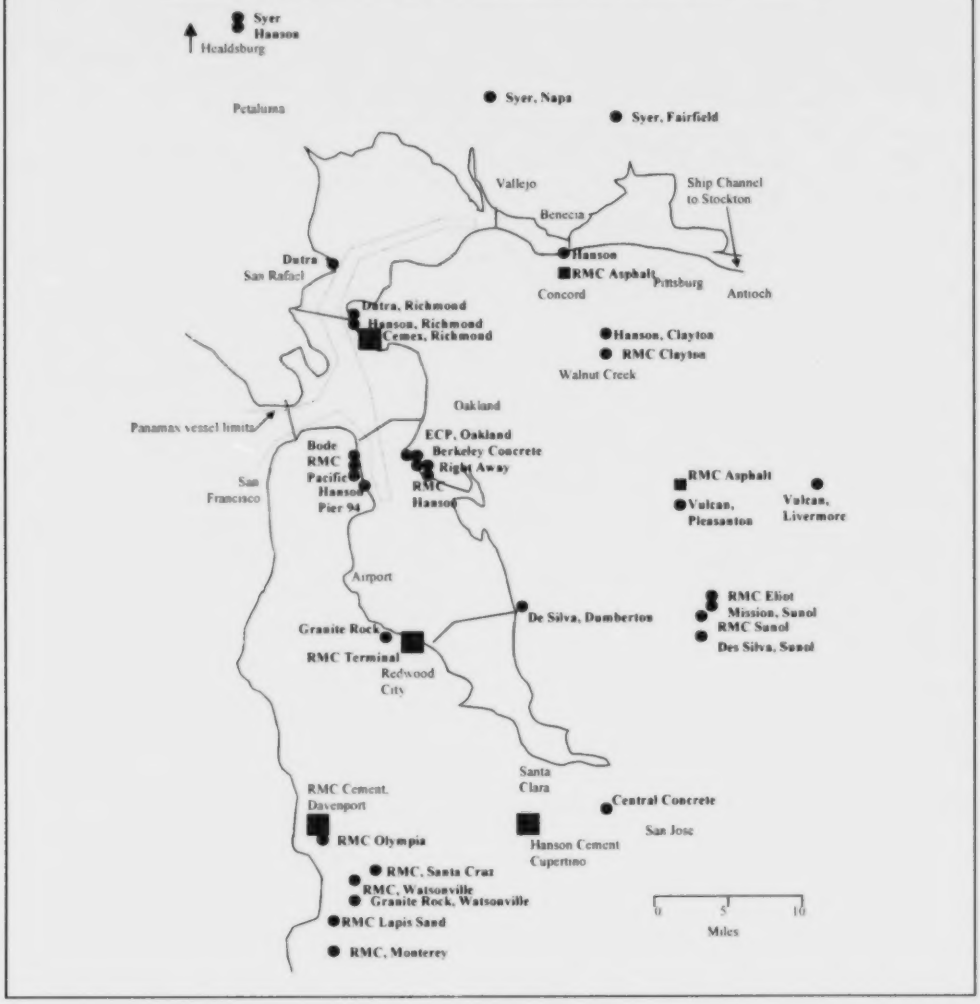
Port Access

Port access is a key factor for any new entrant. Most unloading sites in the Bay area are too shallow to receive more than 50,000 tonne loads from a Panamax-size vessel (70,000 dwt). Figure 5-6 shows a sketch of the Bay area and in particular the water depths greater than 50 feet, including the potential unloading and storage sites. Most docks in the Port of San Francisco have less than 40 feet of draft. Only a small part of the Bay has sufficient draft for a fully loaded Panamax ships. The Port of Richmond has a draft of 38 feet including Berth 7 at Point Potrero Marine Terminal, where Hanson is planning a new aggregate terminal.

Hanson's Pier 94 terminal is one of the few places in the San Francisco Bay that has 40 feet of draft and is suitable for 50,000 tonne shiploads. This facility sets the standard for a new market entrant. Hanson and Mission Rock also share Pier 92, suitable for 30,000 tonne shiploads, which is used for unloading sand and gravel barges. Further south, RMC has a terminal in Redwood City, suitable for unloading 26,000 tonne shiploads in Panamax sized ships, which has shallower draft requirements.

Figure 5-5
San Francisco Pier 94 Aggregate Terminal

Figure 5-6
San Francisco Bay Area Aggregate and Cement Terminals



5.4 SOUTHERN CALIFORNIA

Southern California may be divided between coastal the Los Angeles/Long Beach and coastal San Diego areas.

5.4.1 Coastal Los Angeles

In the Los Angeles market, near Long Beach, ready mix concrete is made primarily with river sand and gravel, rather than with crushed rock. Typically, ready mix plants use 50 percent sand, 35 percent one inch minus aggregate, and 15 percent 3/8 inch minus gravel. These products are more plentiful in the Los Angeles area than either San Francisco or San Diego. Concrete gravel commands the highest prices, since asphalt and road base grade aggregates can be of a lesser specification and

imported material would not be competitive, due to its higher transport costs. In general, road base materials are plentiful in the Los Angeles area. Asphalt plants are located close to the inland quarries making trucking from the coast cost prohibitive.

Vulcan Materials dominates the asphalt business in Southern California and owns many quarries, some with asphalt plants located in the quarries. Vulcan Materials is the US's leading aggregate producer, operating over 300 aggregate plants over the southern and eastern US. Vulcan's Western Division was created in 1999, after acquiring the assets of CalMat in 1998. Vulcan has facilities in Alameda, Fresno, Kern, Los Angeles, Merced, Orange, Riverside, Sacramento, San Benito, San Bernardino, San Diego, Santa Barbara and Ventura counties.

In the Los Angeles area, there are six cement companies with nine plants and three terminals, which compete for the cement and ready mix concrete sand and gravel market. The Topatopa, San Gabriel and Santa Ana Mountains surround the Los Angeles basin and there are more than a dozen aggregate operations within 40 miles of the Port and close to most of the ready-mix plants that are their most important customers (Figure 5-8). Most of the ready-mix plants are about 40 to 80 miles east of Los Angeles, which is distant from tidewater.

Port Access

The Port of Los Angeles and the adjacent Port of Long Beach have recently expanded. Part of the crushed rock used to construct these docks came from BC. The new port facilities are intended for higher value container service and there are only a few sites in the Ports suitable for unloading lower value aggregate. Most properties in the Port are publicly owned and leased over long terms to private operators. In order to use these properties fees must be paid both to the leased operator and the Port.

Figure 5-7
Port of Long Beach

Hanson unloads barges of aggregate from the Baja in the Port of Long Beach at Pier D, Berth 44 (at the Long Beach Marine Aggregate Terminal), which is leased by Connolly Pacific.[39] Connolly Pacific indicated that Berth 40 (near Berth 44) is under consideration for development as an aggregate terminal. The operating cost at the site was reported to be about $3.50 per tonne based on 500,000 tonne per year throughput, however, the site maybe limited to a 50,000 tonne shipment.

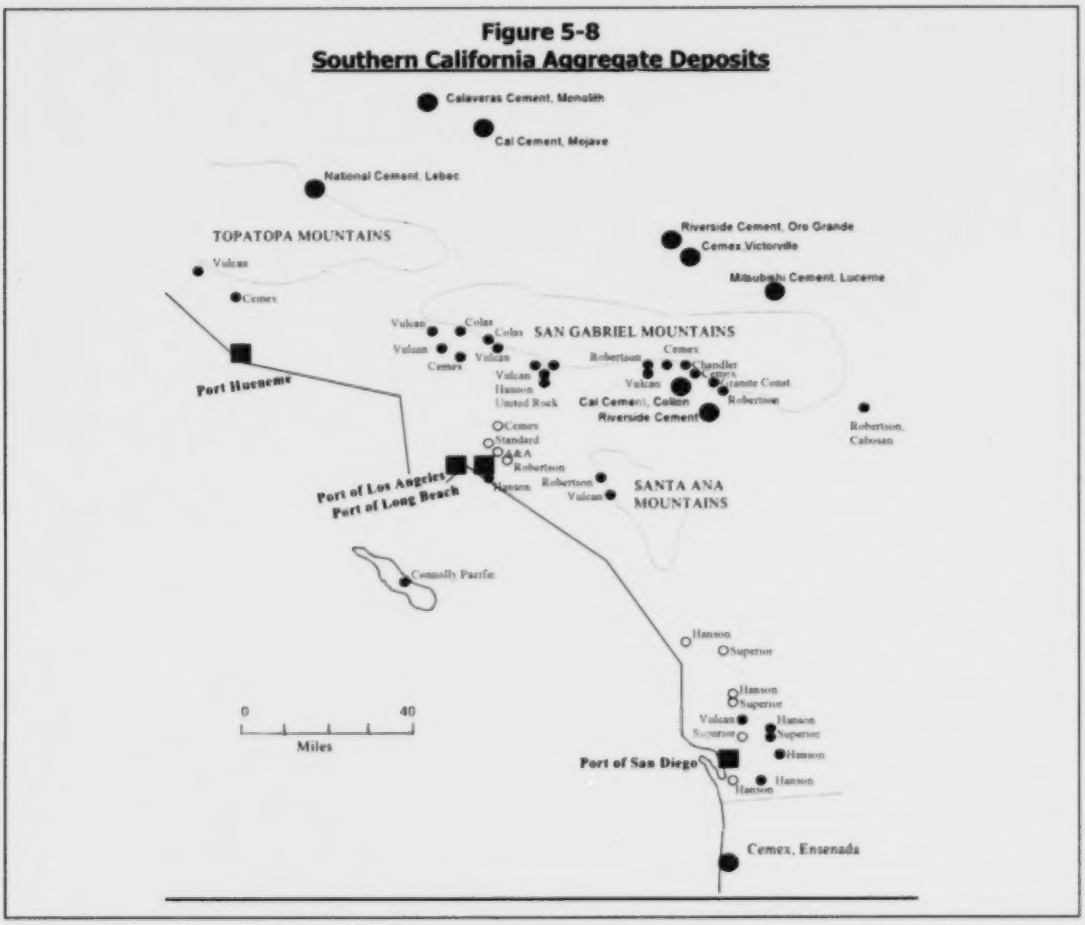
If a publicly owned site could be obtained, stevedoring companies estimate port costs would be in excess of $US 6.00 per tonne to cover unloading, storage and loading onto trucks. Metropolitan

[39] The 6-acre property is owned by L.G. Everist Company, leased by Connolly Pacific, and subleased to Hanson. CP pays $240,000 per year for 2002, $560,000/y from 2003 to 2009, and at least $500,000/y from 2010 to 2019. From 2010 to 2035, the lease payment is $100,000/ plus $US 0.50/ton of construction material transported off the premises payable quarterly up to a maximum of $US 500,000/y and a minimum of $US450,000/yr. Source: MDU Resources Group Inc., Security Exchange Commission Filing, Delaware, March 8, 2000.

Stevedores has been working on a proposal to Hanson to unload Panamax ships at Pier G, Berth 212 Pad 7. The water depth is 50 feet, which can accommodate a fully loaded Panamax vessel. Port costs are estimated to be about $US 6.77 per tonne, made up of $US1.27 per tonne for wharfage, $US1.10 per tonne for land leasing, and $US4.40 per tonne for stevedoring.

Within the Los Angeles area the location of some the key aggregate suppliers, cement and ready mix plants is shown in Figure 5-8. Large new aggregate sources are being developed about 60 miles further inland near Palm Springs.

Figure 5-8
Southern California Aggregate Deposits



5.4.2 Coastal San Diego

The market for aggregate in the San Diego area is approximately 9 million tons per year. The market for sand used in ready mix concrete is about 2.2 million tons per year. Most of this sand is produced from crushed rock, but Hanson also uses river sand and imports sand from the Baja.

Most of the ready mix plants are located at quarries about 14 miles inland from the Port of San Diego. Except for the south San Diego plants it would cost about $4.00 tonne to haul sand from the

Port to the ready mix plants. Adding port and shipping charges makes the imported sand likely too costly for most San Diego ready mix plants. However, a premium may be paid for better quality BC sand.

Port Access

Almost directly downtown in San Diego, Hanson occupies the north section of a warehouse in the 10th Avenue Terminal, Berth 10, where sand is unloaded from barges from the Baja and stored. The water depth at this site is 41 feet, suitable for 50,000 dwt. shiploads. The opposite end of this warehouse is occupied by Cemex's bulk ship unloading, storage and loading system for cement.

Stevedoring Services of America (SSA) unloads the 3,000 tonne barges from the Baja. The barges are 60 ft wide by 260 feet long with an 8 ft high steel wall. There is a loader on the barge, which feeds a conveyor off the barge. Unloading costs are estimated to be about $3.00 per tonne.

Several companies have previously proposed transferring shiploads of aggregate to barges for storage and subsequent unloading. This idea has been considered to be impractical for environmental and commercial reasons. The present volume of 500,000 tonnes per year is considered to be more than desirable, given that the San Diego convention center and other tourist attractions are nearby.

Hanson, Cemex and Roberto Coryo are continuing to develop the Baja supply and other sources in Mexico. The Baja plant is 85 miles south in Ensenada. These sources will continue to be a significant factor in the southern California market.

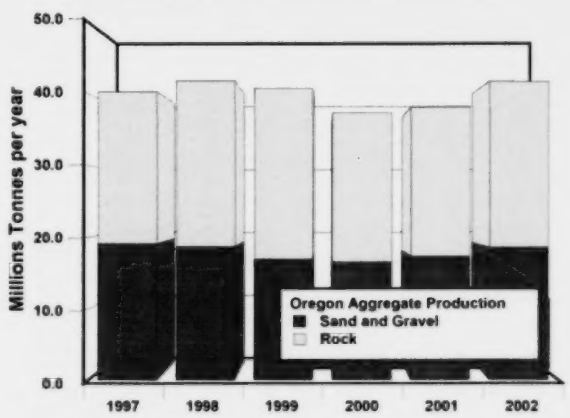
6.0 OREGON

Oregon is a relatively small state with a population of about 3.4 million. Although Oregon is not as attractive as a market as California, selected sales may be possible.

6.1 Consumption

The most populated area of Oregon is the Greater Portland area, which is potentially accessible by water via the Columbia River from coastal BC. Portland is located near the confluence of the Columbia and Willamette Rivers. About 530,00 million live in the City of Portland. In 2002 Oregon consumed 18.5 million tonnes of sand and gravel and 23.2 million tonnes of crushed stone.

Figure 6-1
Oregon Aggregate Production: 1998-2001



6.2 Market

At present, Ash Grove Cement West Inc. ships lime rock from Texada Island by barge to Ashgrove Lime in Oregon using ocean-going barges. Lime rock is a higher valued commodity and can be economically shipped further by barge than aggregates.

The Portland area uses an estimated 3.5 million tonnes/yr. (3.8 million tons/yr.). The largest ready mix plants are located on the Willamette and Columbia Rivers and receive most of their aggregate by barge. An overview of the Portland area market is provided in Table 6-1. Glacier Northwest, Ross Island and Morris Brothers are among the dominant companies in the Portland area.

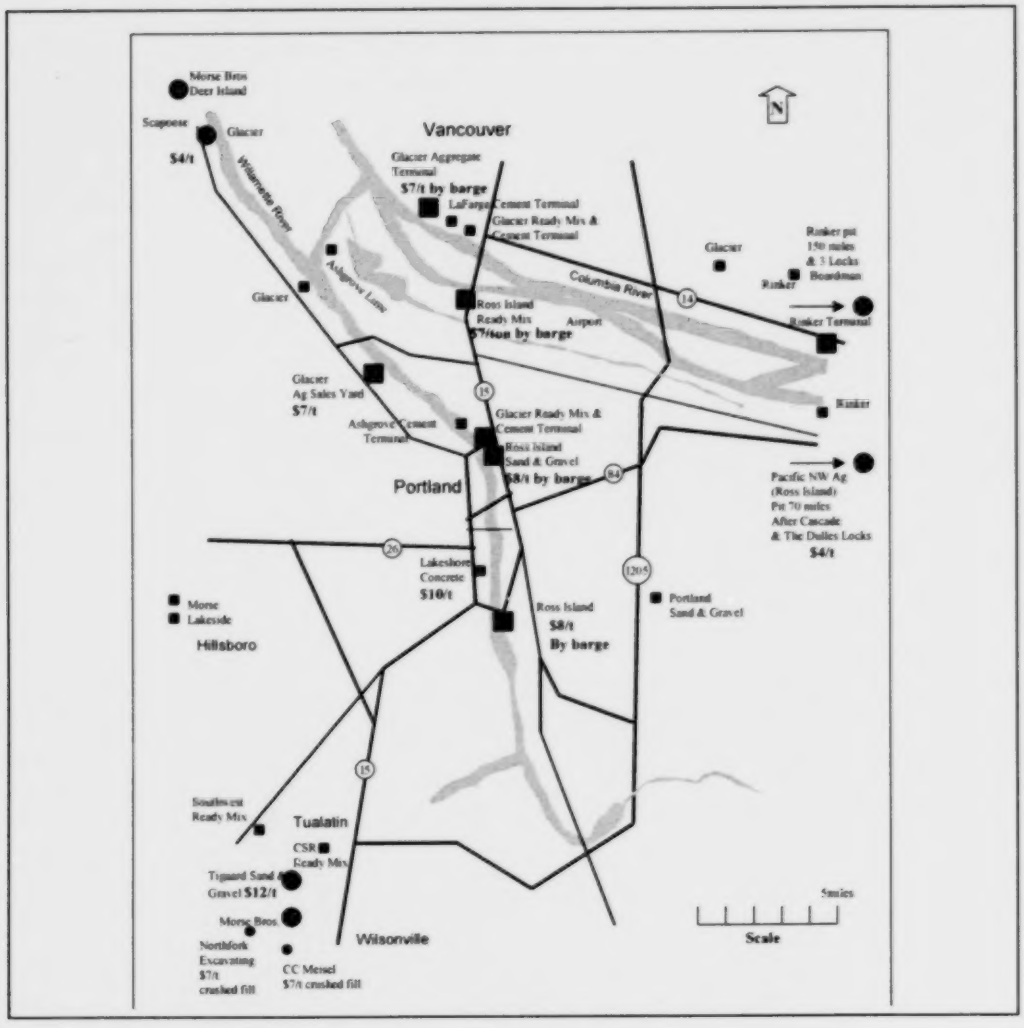
Table 6-1
Water Accessible Portland Area Aggregate Market

Supplier	Amount	Subtotal	Price
Glacier Northwest	(tons/yr.	(tons/yr.	($US/ton)
Scapoose	1,000,000		3.50
River dredge	300,000		4.00
Subtotal		1,300,000	
Ross Island Sand & Gravel			
Pacific NW Ag	700,000		4.00
River dredge	200,000		
		900,000	
Morris Bros.			
Wilsonville	400,000		
Deer Island	200,000		
		600,000	
Rinker Materials, Boardman		400,000	
Tigaard, Tualatin		250,000	12.00
Baker Rock Resources, Scapoose		50,000	
CC Meisel, Wilsonville		50,000	7.00
Northfolk Excavating, Tualatin		50,000	6.50
Teevin Bros. Land & Timber, Wauna		20,000	
Kynsi Construction, Wauna		10,000	
Westside Rock, Rainier		10,000	
Northwest Ready Mix, Astoria		50,000	
Other		160,000	
Total		3,850,000	
Users			
Glacier			
Portland center	400,000		8.00
Portland northwest	200,000		7.50
Portland West Ag terminal	100,000		
Vancouver west	400,000		6.75
Vancouver east	100,000		
Subtotal		1,200,000	
Ross Island Sand & Gravel			
Portland Center	300,000		8.00
Portland North	300,000		
Portland South	100,000		
		700,000	
Lakeside Industries, Hillsboro		400,000	
Rinker Materials, Vancouver		300,000	
Lakeshore Concrete, S. Portland		100,000	10.00
Baker Rock Resources, Scapoose		50,000	
Big River Excavating, Astoria		50,000	
Other		950,000	
		3,850,000	

Major Players

The location of the major gravel suppliers and the major users are shown in Figure 6-2.

Figure 6-2
Portland Area Concrete Aggregate Suppliers and Locational Prices



Glacier Northwest

Glacier Northwest is the leading ready mix company in the Portland area.[40] Their ready mix plants are relatively new and their gravel operations are the largest in the Portland market area. Glacier

[40] Glacier Northwest dominates both the Portland and Seattle markets. Glacier Northwest is a subsidiary of Taihaiyo Cement Corp., Japan's leading cement maker with 40% of the Japanese market and $8 billion in sales in 2003.

Northwest has two cement terminals, one adjacent its central Portland ready mix plant and the other near its two Vancouver, Washington ready mix plants. Glacier has aggregate sales terminals that are independent of ready mix plants, however, the volume of sales at these terminals appears small. Glacier's main aggregate deposit is on the Willamette River about 20 miles northwest of Portland near Scapoose (upper right-hand corner Figure 6-2).

Except for Astoria and Rainier on the lower Columbia River, Table 6-1 excludes gravel operations outside the Portland area and includes only that part of the market that might be supplied from BC. The approximate dividing line for river-supplied aggregate (and inland suppliers) is about 10 miles south of the center of Portland and 10 miles north of Vancouver, Washington.[41]

Ross Island

Ashgrove Cement and LaFarge Cement have cement terminals in Portland and Vancouver area and supply Ross Island Premix and other companies. Ross Island's subsidiary Pacific Northwest Aggregates Inc. has its main aggregate deposit on the Columbia River about 20 miles east, which supplies aggregate to the ready mix plants by barge. The Scapoose barging system is relatively convenient, however barges from the NW Aggregates must pass through the Cascades and The Dalles locks on the Columbia River.

Ross Island's requirement for about one million tonnes per year of concrete sand and gravel may present an opportunity for BC suppliers. Ross Island has three ready mix plants with 29 concrete trucks and two barge terminals one on I-5 near the Columbia River. The company has two locations near the center of city and one of these sites may be a potential unloading site for BC shipments.

Morris Brothers

Morris Brothers is one of Oregon's leading aggregate suppliers.[42] Morris Brothers uses a rail shuttle system to deliver aggregate to terminals south of Portland, including Lakeside Industries' pit and asphalt plant in Hillsboro, which is about 10 miles west of Portland. The rail cost is about $3.00/ton on the relatively smaller Portland & Western/Willamette & Pacific Railroad. For similar hauls from Scapoose to Tualatin, the rail quote from the larger railroad companies (e.g., Union Pacific and Burlington Northern) to Glacier Northwest was $10.00/ton.

There are other companies, including Rinker Materials,[43] Tigard Sand & Gravel, C.S. Meisel, and others that supply about 40 percent of the aggregate requirements in the area. Rinker has barge-offloading sites on opposite sides of the Columbia River at Vancouver, Washington and Portland. Tigard has an aggregate deposit in southeast Portland. CS Meisel also has a small pit in the same area and recently bought a 500-acre site 35 miles south of Portland in McMinnville.

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[41] For example, a small independent ready mix plant, Lakeshore Concrete, 6 miles south of the city, brings aggregate from pits about 10 miles to the south of it, at a delivered cost of $10/ton. It is cheaper to haul on I-5 from the south than it would be to bring aggregate through the city from riverside terminals

[42] Morse Bros. is one of Oregon's largest suppliers of aggregates, asphaltic concrete, ready mix concrete, and related products. They have 650 employees in 29 separate locations in Oregon, generating approximately $123 million in annual sales.

[43] Rinker Materials Corporation, headquartered in West Palm Beach, Florida, operates in 31 states across the country, employing more than 10,500 people at over 381 locations. Rinker is the fifth largest aggregates producer in the US, supplying over 84 million tons per year, and the second largest producer of pre-mix concrete, supplying over 13 million cubic yards each year.

River Sand

Glacier Northwest owns river dredges that are designed to wash the sand as it is moved to the barge. The dredged river sand is relatively clean compared to sand from San Francisco Bay. Ross Island operates dredges on the Columbia River and in California on the Stockton ship canal.

A major dredging project is proposed for the Columbia River, entailing the deepening of the navigable channel from 40 to 43 feet to accommodate larger ships. Most of the environmental approvals have been obtained. This dredging project will increase the availability of river sand, which will likely depress sand prices. The quality of Columbia River sand is relatively good and up to 20 percent can be used in concrete.

River Barge Transport

Gravel deposits all along the Columbia River can be accessed by river barge. Barges are used to transport aggregate from two large deposits west and east of Portland to the ready mix plants and sales terminals on both sides of Columbia and Willamette Rivers. At the aggregate operation the transfer price is about $4.00/ton or less to the ready mix companies plus the cost of barging, although it is reported that Glacier pays about $3.50/ton. For relatively small loads (i.e., 2,200 ton and one 3,200 ton self unloading barges), barge costs are in the order of $3.00 per ton to the ready mix plants.[44] Ross Island uses slightly narrower 2,000-ton barges that are required to fit through the river locks further up the Columbia River.

Rinker Materials has a barge unloading terminals in Camas just east of Vancouver, Washington and in northeast Portland on opposite side of the Columbia River. Rinker brings in 8,000-ton self-unloading barges of aggregate from their Boardman aggregate deposit and occasionally brings in aggregate from Ross Island's (Pacific Northwest) aggregate deposit.

Rail Shuttle Transport

Since 1999, Morris Bros has shipped aggregate by rail from its operation near Salem, which is about 35 miles south of Portland to Hillsboro, southwest of Portland.[45] The rail haul handles most of the Salem aggregate operations output. About 260 trainloads transport about 500,000 tons/yr. of aggregate into the Portland area, which eliminates approximately 4,700 truckloads.

The rail shuttle includes 17 rapid-discharge, 113-ton-capacity railcars and operates the rail cars as a unit train. The rail loadout facility includes two 700-ton-capacity overhead silos, a 36-in.-wide, 1,000-ft-long inclined conveyor, two conveyor loading hoppers, a control booth and an automated control system that handles car loading and weighing. Both silos usually are loaded with the same product, but the system is capable of shipping mixed-product loads. The cars are flood-loaded to capacity as the locomotive slowly pulls the cars past the silos. With each car taking less than 2 minutes to load, the entire process of loading the railcars can normally be accomplished in 45 minutes.

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[44] Glacier has occasionally brought in larger 9,000-ton barge from their Dupont deposit on Puget Sound (just south of Tacoma) around the Olympic Peninsula to Vancouver, Washington. However, these shipments from Dupont were based on the availability of some surplus material there and special barging rates.

[45] Rock Products, October, 1999 http://quarrytour.rockproducts.com/ar/rock_rock_rail_rolls/index.htm

At the unloading terminal, an arriving train is positioned over a below-grade, 120-ton-capacity receiving hopper. The gates on the first rail car are opened and the unit is completely emptied in 4 minutes. The entire unloading process takes about 75 minutes for a 17-car unit train. Once unloading begins, product flows by inclined conveyor from the receiving hopper to a horizontal conveyor above the bins, and then is diverted by the tripper car to the correct bin. From there, the stockpiled product is conveyed to the on-site asphalt or ready-mix plants. The terminal also serves as a distribution yard for Portland-area customers.

Ready mix plants have three to five silos of different aggregate sizes. Each of the hoppers is relatively small and serviced by a just in time delivery system. Trucks can keep the hoppers full but there is no room for multiple rail car size shipments. An existing gravel pit is used to store and distribute the excess rail delivered aggregate. The existing users, an asphalt plant and ready mix plant are on site.

To be competitive, the price that a BC supplier would have to meet for the highest quality material is about $US7.00/ton ($US 7.70/tonne). To be interested in BC aggregate, buyers would want a price about $US5.00/ton ($US5.50/tonne). Oregon suppliers reliant on barging from sites upstream on the Columbia may pay more, because their barging costs are higher

Product Quality

Product characteristics influence price. Chemical reactivity often eliminates some of the smaller suppliers and their product is suitable only for fill or asphalt. Therefore many of the smaller operations focus on the construction fill market where prices are lower. Fill is priced at about $4.00/ton ($4.40/tonne). Higher quality crushed rock is priced about $7.00/ton ($7.70/tonne). Although sand prices are higher in the south of Portland, sand prices are generally low because supply is abundant. Prices are also quantity dependant for 10 to 20 truckload shipments, that is 200 tons or more. A list of the some of the prices arranged by product and quality is provided in Table 6-2 for the Portland area.

Table 6-2
Portland Area Aggregate Prices

Product	Glacier Vancouver	Tigaard Tualatin	Northfork Tualatin
Sized Rock	($/ton)	($/ton)	($/ton)
Rip Rap 50-100lb		20.00	15.00
Round rock 2"-6"		15.00	
Round rock 1 ½-3/4		14.00	
Round rock ¾-1/4		12.50	
Pea gravel 3/8-#4	11.35	13.75	
Concrete sand		11.80	
Clean crush ¾-1/2, ½-1/4		11.20	
Chip seal ¼"-0, 10"-0		11.20	
Turkey grit	10.75		
Boulders		10.00	
Crushed Rock 4"-1 ½, 4"-0		8.00	
Concrete Ag 1" X #4	7.75		
Crushed Drain 1 ½-3/4	7.50	8.00	7.64
Sand			
Sandy loam		9.70	
Filter sand	6.75		
River dredge sand	5.75		

Mason sand	5.75	12.85	
Course sand	5.50		
Road Base			
Base Ag 5/8"-0, 1 ¼"x0	6.65		
Crushed Rock 4"-0, 1 ½-0		7.30	6.54
Fill			
Pit run (unscreened)		4.30	5.50
Fill sand	4.25	9.00	
Reject 1 ½"		3.50	
Reject ¾"		3.00	
Fill dirt		5.00	1.60
Reject Fill sand	2.75		1.50
Overburden		1.00	

6.3 OPPORTUNITIES

There are some projects proposed along the Columbia River in Portland that will require large quantities of aggregate. Company representatives said that there might be an opportunity to supply such a large order with shiploads from Canada. The aggregate could possibly be delivered directly to the fill site by a ship's conveyor. A large contaminated site clean up by the US Army Corps of Engineers is one upcoming project.

The competitiveness of a BC supplier selling into the Portland area market depends mainly on the transportation costs. A 10,000-ton shipment by barge would cost about $10.00/ton based on the lowest of several barging company budget prices. The barge must be suitable and approved for travel in the open ocean off the Olympic peninsula. At present there are only two BC barges with such approvals. Once the barge reaches Astoria, Oregon, it must travel 90 miles up the Columbia River and possibly the Willamette Rive. Maximum draft is another issue that limits the size of the barge (e.g., 10 feet in Vancouver).

Shipping costs could be as low as $8.00/ton for 30,000-ton shipments. However, only one of the customer sites might be able to receive a shipment of this size. Ross Island's main plant has 18 feet of draft. This draft would limit the shipment size to about 15,000 tons. An option would be to unload at a terminal with more space and deeper draft away from a ready mix plant, but there would be added trucking costs.

In sum, draft limitations tend to preclude the possibility of regular shipment by bulk carrier to the Oregon market and their associated low transport costs, which are possible in California. For a BC supplier to make inroads in the Portland market with the economies of larger shipments, many obstacles would need to be overcome.

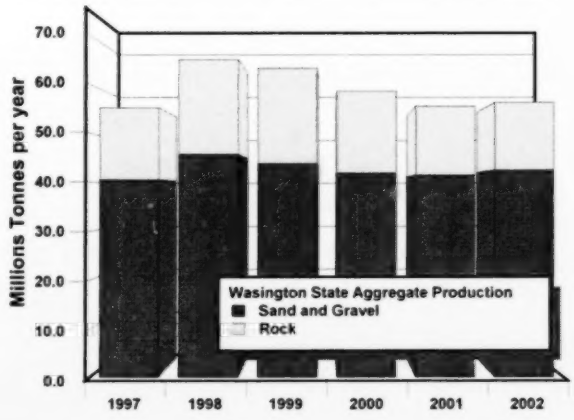
7.0 WASHINGTON

The primary accessible coastal market area of Washington State is the Puget Sound which includes the key markets of Seattle-Tacoma.

7.1 Consumption

The State of Washington used a total of 59.2 million tonnes of aggregate, composed of 41.1 million tonnes of sand and gravel and 18.1 million tonnes of crushed stone in 2001.[46] This is 60 percent more than the 37.9 million tonnes used in BC in 2001. Washington per capita aggregate use was 9.9 tonnes, which is slightly higher than BC's 9.2 tonnes per capita.[47] The population of Puget Sound is about 3.9 million, and combined with Southwest BC, the total population is about 7.0 million. The US per capita aggregate consumption rate is 9.7 tonnes per capita.[48]

Figure 7-1
Washington State Aggregate Production: 1998-2001



7.2 MARKET

Glacier Northwest dominates the aggregate market in the Puget Sound area, as well as the Portland area (discussed earlier). Glacier Northwest operates a small cement terminal in the Port of New Westminster

DuPont Aggregate Operation

Glacier Northwest operates a large aggregate operation on the water 10 miles south of Tacoma (see Figure 7-3). The DuPont plant opened in 1997 and produces about 4.5 million tons (4.1 million

[46] Washington State Department of Natural Resources (2001) ***The Mineral Industry in Washington***. From US geological Survey Mineral Yearbook – 2001.Chapter 50.4 and various years.
[47] http://quickfacts.census.gov/qfd/states/53000.html
[48] USGS (2002) ***Socioeconomic Dimensions of Aggregate of Supply and Demand***. http://pubs.usgs.gov/of/2002/of02-350/aggregate.pdf

tonnes) per year.[49] The site permitting process took 10 years. This operation supplies more than 75 percent of the Seattle-Tacoma market up to 5 miles west of Puget Sound.[50] The DuPont operation is located on 344 acres leased from Weyerhaeuser, however the processing plant and aggregate piles occupy about 52 acres. A 48-inch wide conveyor conveys aggregate 4,000 feet to the loading dock.[51]

The deposit has been well explored and contains 100 million tons of reserves and another 100 million tons on an adjacent 200-acre parcel, which suggests a reserve life of 40 to 50-years. The aggregate is clean with a good size distribution with about 2 percent fines under 200 mesh. There is a shortage of concrete grade sand and crushing is required. Most of the crushed rock is sold to asphalt customers.

Eighty percent of the output from the DuPont operation is shipped by water. The depth of water at the dock is 48 feet. Barges up to 10,000 tons capacity are loaded at a rate of 2,400 tons per hour. Most barges bound for local markets are about 3,500 tons in capacity. The round trip to Seattle takes about 24 hours. During the summer, barging is conducted seven days per peek, primarily at night, with only a few hours between shipments.

Figure 7-2
DuPont Aggregate Plant South of Tacoma

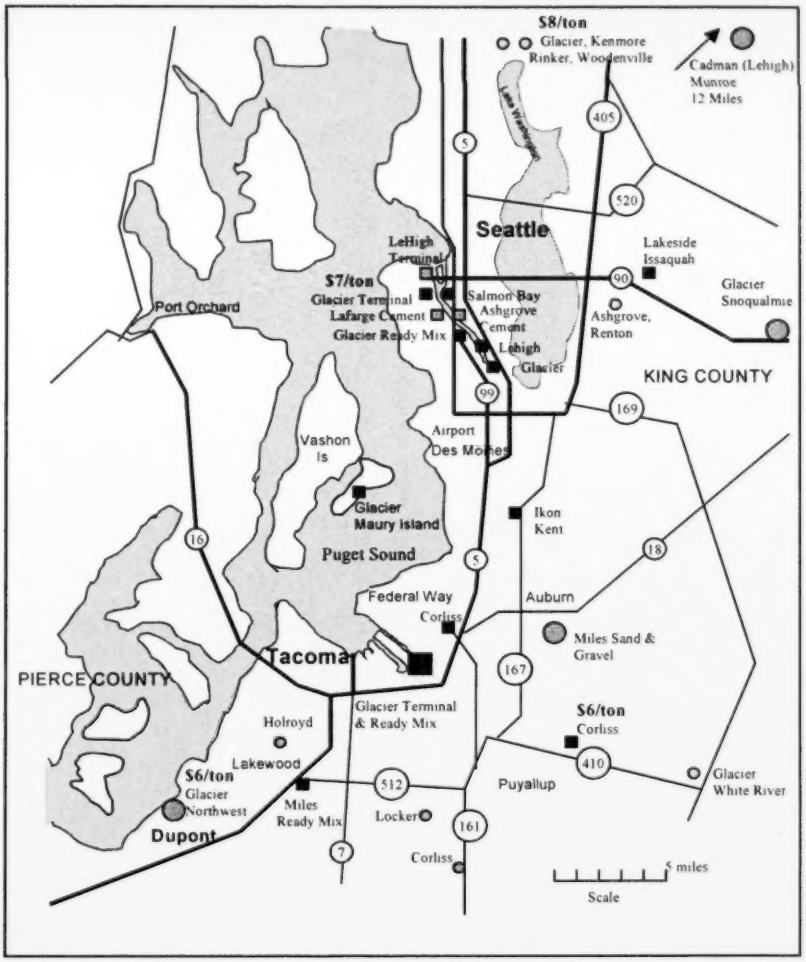
Glacier Northwest has a barge-unloading terminal and ready mix plant in Tacoma. The site is small with little room for gravel storage other than for Glacier's ready mix and asphalt plant. Due to the limited space at the Tacoma site, barges are limited to about 3,600 tons. There is sufficient draft for 30,000-ton bulk carriers if the necessary space could be obtained.

Seattle

Glacier Northwest has a ready mix plant, an aggregate terminal and two cement terminals in Seattle The ready mix plant includes a cement unloading system with several silos and two large bins each holding about 1,000 tons of cement. There are five concrete walled bunkers that hold about 500 tons each of different grades of aggregate used in the concrete mixes. These bunkers can be filled from conveyors directly from the barges. There is no additional space at the Seattle site.

[49] The DuPont exceeds the current production of Canada's largest sand and gravel operation at Sechelt at 3.1 million tonnes.
[50] http://www.djc.com/special/concrete97/10024308.htm
[51] Rock Products, April 1, 1998 http://rockproducts.com/mag/rock_plant_plans_pay/index.html

Figure 7-3
Seattle-Portland Area Aggregate Suppliers and Locational Prices
(Prices for Standard 1" x #4 Gravel)



Cadman ready-mix (a subsidiary of Lehigh Cement) buys aggregate from the Dupont deposit. Prior to the increase in the Canadian dollar, Lehigh used to bring aggregate from the Sechelt pit by barge. Lehigh also brings about 300,000 tons per year of sand from their Construction Aggregate's operation in Victoria. Lehigh trades some of this Victoria sand for DuPont aggregate. Although, Lehigh has a large gravel pit and rock quarry in Munroe (about 25 miles northeast from its Port of Seattle ready mix plant) the DuPont gravel from Tacoma is more competitive. Another, ready-mix company Salmon Bay Ready Mix in the Port of Seattle also uses DuPont gravel.

Lafarge Inc. operates a 420,000-ton/year cement plant in Seattle and has a cement terminal and ready mix plant in Seattle. Lehigh supplies cement to the ready mix plants of Corliss Resources[52],

[52] Corliss Resources Inc. web page http://www.corlissconcrete.com/index.htm

who is also the second largest aggregate supplier in the area. Ash Grove Cement, operates a 500,000-ton per year cement plant, a lime plant and a ready mix concrete plant in the Port of Seattle and a limestone quarry on Texada Island (see Section 4.2). Lafarge and Ash Grove import about 2 million tons per year of lime rock from their Texada Island quarries to the Port of Seattle.

Market Supply Balance

The water accessible aggregate market balance for the Seattle-Tacoma area is summarized in Table 7-1.

Glacier dominates the market by producing about three quarters of the concrete aggregate in the area. Approximately 1/3rd of the 4.5 million tons (4.1 million tonne) per year production at Dupont is used in Glacier's ready mix plants. Glacier has three other aggregate operations each about 15 miles to the north, east and south of Tacoma, but these deposits are generally higher delivered cost. Supplies are only drawn from the inland pits when the combined barge, terminal, and trucking costs from the water exceed the cost of drawing directly from the inland deposits. For the south side of Tacoma aggregate is trucked from DuPont.

In addition to Glacier, Corliss Resources and Miles Sand and Gravel are important aggregate suppliers and users in the water accessible Seattle-Tacoma market. Corliss Resources has aggregate operations to the north, east, and south of the Port of Tacoma all within eight miles of the port, which provide competition for barge shipments to the Port. It would be difficult for an external supplier with added barging, terminal and trucking costs to match Corliss prices in the Tacoma area except directly at the dockside.

Other Producers

The barge accessible suppliers and users listed in Table 7-1 represent about half of the total consumption west of the Cascade Mountains. There are over 40 other producers of aggregate at 90 other locations west of the Cascades. The largest of these companies and some of their main plant locations are as follows:

- Central Reddi-Mix, Centralia, Chehalis.
- Concrete Nor-West, Anacortes, Burlington, Mt. Vernon, Oak Harbor.
- Fred Hill Materials, Port Orchard, Port Townsend, Sequim.
- Martin Marietta Materials, Granite Falls, Mount Vernon.
- Rinker Materials, Woodinville, Granite Falls, Everett, Burlington, Gig Harbor, Snohomish.
- Wilder Construction, Everett, Bellingham, Olympia.

Table 7-1
Estimated Water Accessible Seattle-Tacoma Area Aggregate Market

Suppliers	Amount	Subtotal
Glacier Northwest, Dupont	(tons/yr.	(tons/yr.
Dupont		4,500,000
Corliss Resources Inc.		
Puyallup	500,000	
Sumner	300,000	
Federal Way	100,000	
		900,000
Miles Sand & Gravel, Auburn		800,000
Lehigh, Victoria		
Victoria	400,000	
Sechelt	100,000	
		500,000
Ashgrove, Renton		200,000
Lakeside, Issaquah		200,000
Ikon, Auburn		200,000
Other		300,000
Total		7,600,000
Users		
Glacier Northwest		
Seattle ready mix plant	700,000	
Port of Tacoma	400,000	
Dupont	300,000	
Seattle aggregate yard	100,000	
		1,500,000
Corliss Resources Inc.		
Puyallup	200,000	
Sumner	100,000	
Federal Way	100,000	
		400,000
Miles Sand & Gravel Company		
Auburn	200,000	
Tacoma	200,000	
		400,000
Lehigh Cement (Cadman Seattle Inc.)		400,000
Ashgrove (Stoneway)		400,000
Salmon Bay Ready Mix		400,000
Holroyd, Lakewood		300,000
Prefab concrete products		400,000
Alaska		30,000
Subtotal concrete products		4,230,000
Lakeside, Issaquah (asphalt)		700,000
Ikon Materials, Auburn (asphalt)		500,000
Other asphalt		600,000
Other (includes pit run to commercial & residential users)		1,570,000
Total		7,600,000

The aggregate market west of the Cascade is summarized in Table 7-2. Aggregate consumption west of the Cascades amounts to about 33 million tonnes. About 24 percent of the consumption is for concrete aggregate, the highest priced product.

Table 7-2
Aggregate Market West of the Cascade Mountains[53]

Use	Quantity		Value	Price
	('000 tons	(Percent)	($ '000)	($/ton)
Concrete Aggregates	7,032	24	$49,500	6.32
Asphalt Aggregates	1,397	4	8,080	5.78
Road Base And Coverings	4,466	13	23,300	5.22
Fill	5,137	16	13,900	2.70
Railroad Ballast	99	-	583	5.89
Other Miscellaneous Use	637	2	4,446	6.97
Unspecified	13,880	41	70,180	5.06
Total West of Cascades	33,448	100	170,000	5.08

Aggregate Prices

Glacier's DuPont operation dominates the local market, which keeps suppliers' prices low. The two main competitive pits, Corliss Resources, Puyallup, and Miles Sand & Gravel, Auburn, match Glacier's Dupont prices, but some of the smaller pits have higher prices in proportion to the added trucking costs.

As shown in Table 7-2, the average price of aggregate, west of the Cascades was $5.08/ton in 2001 (Washington average $4.83/ton). The average price of concrete aggregates west of the Cascades was $6.32/ton. Most gravel products list for $6.65/ton at the Dupont pit and $9.85/ton picked up at the terminal in Seattle. Road base is priced at $8.95/ton and screened gravel fill is about $6.00/ton at the Seattle terminal. The weighted average list price at the Dupont pit is $6.50/ton and at the terminal in Seattle about $8.70/ton. Large trucking and construction companies can expect a 10 percent discount.

The large long term contract users in the Tacoma Port area, pay about 20 percent less, about $5.25/ton for 1" x #4 concrete aggregate at the DuPont operation. Using 3,500-ton barges, transport 30 miles from Dupont costs about $1.50/ton and the delivered price is therefore about $6.75/ton. The ready mix plants contract their own barges and so these barging prices include only loading costs.

Lehigh Cement's subsidiary, Cadman Inc. ships a 6,000-ton barge load from DuPont to the Port of Seattle at a cost of $1.10/ton. The delivered price in Seattle is $6.35/ton. Lehigh's internal transfer price for similar aggregate from the Sechelt pit is about $4.00/ton. Lehigh's cost for barging in 10,000-ton barges of sand 90 miles from Victoria, BC, to the Port of Seattle costs an average of $1.68/ton. The 150-mile trip from Sechelt, BC, costs $2.50/ton for a total price of $6.40/ton delivered in Seattle. Barging costs should decrease by the fall of 2004 when the barge slip at Lehigh

[53] US Geological Service, 2002 http://minerals.usgs.gov/minerals/pubs/state/2002/wastmyb02.xls

is dredged to 20 feet of draft. At the present 16 feet of draft, a maximum 10,000-ton barge can be brought in at high tide.

7.3 OPPORTUNITIES

One project that may provide an opportunity for Canadian suppliers is the expansion of the Sea-Tac Airport. This project will require about 20 million tons of fill including 15 million tons for the third-runway embankment. To meet the demands of this project, Glacier has proposed to expand its existing small 10,000 ton/yr. pit and dock on nearby Maury Island, offload at a new dock at Des Moines (between Puget Sound and the airport), and convey fill through Des Moines up to the airport. People on Maury Island and in Des Moines have opposed this plan.[54]

BC suppliers may also face opposition to a conveyor offloading system. However BC suppliers could provide an alternative to the pit development on Maury Island. The key to success for new BC entrants to the Seattle market will be to have a cost competitive deepwater barge loading system immediately beside the gravel operation

The competitiveness of BC supplies depends on matching Glacier's economies of scale, loading efficiency and barge transport costs, given the exchange rate situation. At a contract price similar to Lehigh's price of $6.35/ton in the Port of Seattle, the netback after barging cost of $2.00/ton would be $4.35/ton on board the barge in BC. At an exchange rate of $0.75 Can/$US, this price is equivalent to $C6.38/metric tonne.

In sum, current shipments suggest that high quality Sunshine Coast and Vancouver Island aggregate shipped from private operations with existing loading facilities may be competitive. Any of these companies is positioned to bring in BC aggregate to penetrate the Puget Sound market, but Glacier's efficient DuPont operation maintains competitive prices, which makes major access into this market difficult.

[54] Newsletter of the Commission on Regional Airport Affairs, April 19, 2003
http://www.rcaanews.org/Webletter_2003_April%2016/Art7_Maury.htm

8.0 OTHER PACIFIC MARKETS

BC aggregates have been sent to other Pacific markets, such as Alaska and Hawaii. To date these have been one-off sales, usually fulfilling a specified need.

8.1 HAWAII

There is a shortage of good quality concrete sand in Hawaii and concrete is usually made from sand derived from crushed coral limestone or basalt rock. Specialty sands, such as masonry sand and golf course sand are also in short supply and command premium prices. Prices of concrete aggregates are much higher than on the continental US. The average price for concrete sand is about $17.00/ton and aggregate fill prices are about twice what they are in the Seattle area.

The overall market quantities and prices for aggregate in Hawaii are summarized in Table 8-1.

Table 8-1
Hawaii Crushed Stone Sold or Used by Producers (2004)[55]

Product	Amount	Price	Value
	('000 tons)	($/ ton)	($'000)
Concrete sand	800	16.62	13,300
Concrete aggregate, graded	980	14.06	13,800
Coarse Aggregate (+1 ½ inch)	150	11.68	1,750
Graded road base	560	11.20	6,300
Asphalt aggregate	310	9.92	3,070
Crushed rock fill	3,800	6.54	24,840
Total	6,600	9.69	64,000

There is a market for about 200,000 tonnes/yr. of natural concrete sand per year at ready mix plants at the Barbers Point Harbor, west of Honolulu. Lehigh has made proposals to serve this market from their Sechelt pit. In 2002, Lehigh shipped sand to Keauhou Kona Construction Corp. to help build greens, tee boxes, and bunkers at a golf course. A 16,800 tonne load of US Golf Association specification sand was transported in a ship to Kawaihae Harbor on the big island of Hawaii.[56] The trip took two weeks, offloading took 4 days and the ocean shipping cost was about $15.00 per tonne. Most imported golf course sand has come from Australia and China.

The main port suitable for aggregate off-loading would be the Campbell Industrial Park, Barbers Point. This site has a cement plant and three ready mix plants. Sand from Maui is offloaded at this site from 2,000-ton barges. Hawaii Cement could accept up to a 30,000-ton shipment and Grace Pacific's nearby aggregate yard up to a 15,000-ton shipment.

Operating with two 800-foot piers and a small barge facility, Barbers Point handles about 3 million tons of coal, scrap iron, fuel, cement, sand and other bulk cargo.[57] Honolulu Harbor, handles 9

[55] Based on US Geological Service, 2002 http://minerals.usgs.gov/minerals/pubs/state/2002/histmyb02.xls
[56] The LeHigh Reporter Online, January, 2002.
[57] Honolulu Star Bulletin, October 9, 1997 http://www.starbulletin.com/97/10/09/news/story3.html

million tons of freight per year, but bulk cargo is discouraged. Kahului Harbor, on Maui handles 2.0 million tons. Other harbors serving the state are the Kewalo Basin on Oahu; Port Allen and Nawiliwili on Kauai; Hilo and Kawaihae on the island of Hawaii; Kaunakaka on Molokai; and Kaumalapau on Lanai.

Coral limestone and relatively high alkali reactivity basalt rock is used to produce aggregate and sand. The main quarries on Oahu are:

- MDU Resources Group Inc., Honolulu (Halawa)
- Ameron International Corp., Honolulu (Kapaa, Sand Island, Kailua)
- Grace Pacific Corp. Honolulu (Makakilo, Kalaeloa, Kapolei)
- Island Ready Mix, Kapolei
- Pacific Aggregate, Waianae
- Laie Trucking & Ready Mix, Laei

The quarries on Maui, Kauai, and the island of Hawaii are:

- MDU Resources Group Inc., Maui, Hawaii
- Ameron International Corp., Maui
- Jas. W. Glover Ltd., (ready mix & asphalt) Hawaii, Kauai
- Con Ag, Hilo, Hawaii (Yamada & Sons)
- Puna Rock Co., Hawaii (volcanic aggregate)
- West Hawthorne Concrete, Hawaii

MDU Resources subsidiary, Hawaii Cement, is the largest aggregate supplier with a quarry on Oahu, a gravel operation and quarry on Maui and on the island of Hawaii. The company has a cement plant and terminal in Oahu and cement terminals on each of the other major islands. One of their ready mix plants is near the port, the other is inland at their quarry. Hawaii Cement brings most of the concrete sand used on Oahu by 2,000-ton barges from their Maui quarry. The sand is offloaded by front-end loaders at Barbers Point.

Ameron Hawaii Ready Mix Concrete, the second largest supplier, operates plants at Kapaa Quarry, Sand Island, and Barbers Point, Oahu and near Kahului and two other locations on Maui. Grace Pacific Corp. is one the main quarry operators who used to supply sand dredged from the Harbor, but this contained too much salt for use in concrete. Island Ready Mix Concrete's plant is also located at Barbers Point.

The lowest quote to the Hawaii government (Department of Budget) in 2003 for construction sand was $31.00/ton delivered. The list price of basalt derived crushed rock sand from Ameron's Kapaa quarry near Honolulu is similar, $30.00/ton. The lowest bid to the State for golf course sand was from Hawaii Cement's Maui quarry at a price of $48.00/ton delivered on Oahu.[58] A representative of Hawaii Cement stated their internal sand cost is $19.00 per ton delivered at Barbers Point. Imported sand could be purchased at this price if it were superior in quality. However, sand has not been

[58] Hawaii Department of Budget and Fiscal Services, April, 2003, http://www.co.honolulu.hi.us/pur/14137.pdf

purchased from the mainland because it is has not been cost competitive. The State of Hawaii allows a 10 percent higher price for concrete made with 25 percent or more local aggregate.[59]

8.2 SOUTHEAST ALASKA[60]

Southeast Alaska offers selective sales opportunities as it has in the past for BC suppliers. For example the Sechelt operation has sent aggregate in 16,000 tonne seaspan scows to Ketchikan Alaska. Ketchikan has one ready mix plant, Ketchikan Ready Mix and Quarry. Sitka's supplier is S&S Contractors. Juneau has four suppliers: RSH Company, Capital Concrete Inc., Juneau Ready Mix Inc., and Southeast Aggregate. Juneau is about 400 miles from Prince Rupert and the many alternative suppliers in the area have prices lower than the barging cost.

In Ketchikan there are several construction projects such as the connection between the town and the airport on Gravina Island and other airport and marine terminal projects in the area. Ketchikan Ready Mix is located on the water across from the airport and can receive 1,500-ton barges. They operate their own rock quarry and bring in sand from their own dredging operation on the Stikine River, which is 120 miles to the north. There are several other quarries on Revilagigedo Island that could be used for fill and for construction aggregate for the proposed bridge.[61]

In 2002, South Coast Inc., Ketchikan, built a 16 km section of road near Ketchikan. Their aggregate costs were $5.36/ton for quarried basalt and $1.80/ton for pit run gravel.[62] The average Alaska price for concrete sand and gravel in 2002 was $5.35/ton and for crushed rock, $5.09/ton. The average unit prices reflected in bid projects for aggregate for State road projects near Ketchikan, is about $10.00/ton. These low prices indicate that it may be difficult to make sales from BC. Barging from Stewart may be competitive with barging from the Stikine River where dredged sand is obtained.

Alaska Basic Industries, the sole cement supplier for much of Alaska, and its sister company, Anchorage Sand & Gravel Inc. are part of the North Dakota-based MDU Resources Group. The state's cement comes from China, South Korea, Puerto Rico, or Thailand.[63]

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[59] State of Hawaii, State Procurement Office, Department of Accounting & General Services http://www2.hawaii.gov/spo/hi-products.pdf

[60] The largest towns in Southeast Alaska and their populations are Ketchikan, 8,500, Sitka, 9,000, and Juneau, 31,000. Wrangell and Petersburg have a population of only 2,300 and 2,000 people respectively.

[61] HDR Alaska Inc., June, May, 2000 http://www.gravina-access.com/project_reports/docs/Geotechnical%20Report.pdf

[62] Board of Contract Appeals, State of Alaska, June 25, 2002 http://www.usda.gov/bca/southcoast99197.pdf

[63] Alaska Journal of Commerce, July 22, 2002 http://www.alaskajournal.com/stories/072202/loc_cement.shtml

9.0 CONCLUSIONS

This study provided an overview of the potential export market for BC aggregates and as a result offers several conclusions for consideration.

9.1 EXCHANGE RATES

BC is a small open economy and a price taker in the export market. BC aggregate exports must compete with local US aggregate producers who price their products in US dollars, which has not been affected by changes in the US/Canadian exchange rate. Since late 2002, the US dollar has depreciated by nearly 20 percent as illustrated in Figure 9-1. This reduces the value of US exports in Canadian dollars to BC exporters.

Figure 9-1
Declining Canadians Export Revenues per US Dollar

The US/Canadian exchange rate is the most important "cost" element impacting profitability of BC exports to the US. Given the thin margins inherent in the export of low valued commodities, such as aggragates, the change in the exhange rate over 2003 has had the potential to lower Canadian dollar returns below a level of minimum profitability. The positive offset of the depreciating US dollar is that producers investing in imported US machinery and equipment are now facing lower costs.

9.2 RESOURCE AVAILABILITY

Many coastal western North American jurisdictions have abundant aggregate resources, however the constraining factors influencing development is location, quality, quantity and regulatory processes. Although the presence of a high-quality coastal aggregate deposit in BC is a necessary condition for development, it is by no means a sufficient condition.

There are many obstacles to overcome relating to marketing, distribution and access into the highly competitive US market. In other word, the physical availability of good quality coastal aggregate is generally not the constraining factor to the development new deposits or expansion of existing operations.

9.3 LAND OWNERSHIP

The extraction of aggregate from Crown Land for commercial purposes requires tenure assignment under the *Land Act*. The tenure agreement usually requires payments of royalties, which are payable irrespective of the specific profitability of a project and results in higher operating costs as compared to private aggregate operations.[64] New projects can be constrained by *Land Act* provisions that prohibit the sale of Crown land for aggregate production.

Based on the existing operations in BC, including operations that First Nations wholly or partly own, only privately owned operations have proven to be competitive in the export market. One advantages of private ownership is that the land tenure acts as collateral to help finance development.

Sale of Crown land, including the aggregate rights can potentially result in higher revenues to government through employment and other taxes that would not be generated in the absence of the project. The loss of an export project implies that other jurisdiction may reap these revenues (e.g., Washington exports to California).

Stakeholders have long argued that the current Land Act restrictions that prohibit selling of Crown Land for aggregate extraction discourages the development of the highest and best use of the land.[65] Following from the 2001 Report of the Aggregate Advisory Panel the following recommendation has yet to be addressed:

> **"Recommendation 41: BCAL should consider whether continuation of the existing *Land Act* provisions that prohibit the outright sale of Crown land for aggregate extraction is in the best interests of the Province."**

The long-term trend is that aggregate prices are steadily increasing, reflecting land ownership restrictions, high costs and difficulties in obtaining regulatory approvals. These are factors that increase transportation distances, which in turn drives up the costs of delivered aggregate. Given that most aggregates are used in public works projects, increasing aggregate costs do not appear to be in the public interest.

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[64] For example on parts of Vancouver Island the royalty is $0.90/tonne. A royalty by definition is a sharing of the resource rent, which through the levying of the royalty implicitly assumes there is economic rent to be shared between the resource developer and the resource owner -- the Crown. If the charging of a royalty precludes development -- the royalty is too high. Royalties that discourages development risks precluding the collection of other tax revenues, such as employment, corporate and sales tax, which accrue regardless of ownership status.

[65] BC Ministry of Energy and Mines (2001) ***Managing Aggregate, Cornerstone of the Economy" Report of the Aggregate Advisory Panel***". Page 29 and 41.

9.4 LOADING INFRASTRUCTURE

Another related constraint affecting exports is the cost of developing loading infrastructure for larger ships. The costs for port infrastructure, including dredging, berthing, and loading equipment, including high-capacity conveyors can be major capital constraints, requiring creditor assurance, such as secure land tenure, and a proven financial track record. The ship loading facilities that have been upgraded in recent years to facilitate increased exports sales to the US have been all undertaken by large international firms, with the financial capacity and private land tenure.

9.5 US PORT ACCESS

The unloading site influences export shipping costs, port storage costs and trucking costs to the buyer. Obtaining a strategic ship-unloading site in the US ports is a critical factor in the feasibility of aggregate exports. Existing port facilities tend to be tightly controlled by existing companies who have agreements with port authorities and tend to be highly integrated with existing ready-mix and cement companies that can dominate material flows within a port. Aggregates are a low-valued commodity and so unloading sites for aggregates tend to be scare, since they must compete with higher-value goods.

Limitations on physical access especially for low-valued commodities are often competitive barriers to restrict access from new entrants by established companies. Offloading from ship to barges in the harbor does not provide a reliable long-term presence in the market. To secure a reliable customer base, such as ready mix customers a permanent ship-offloading site is required. The active companies in the key US ports tend to be larger multinational companies, which have the marketing dominance to thwart new entrants in their market.

9.6 RAIL SHUTTLE OPERATIONS

For marine transportation the use of bulk carriers has led to major decreases in unit transportation costs to California. This has effectively enlarged BC's market area beyond which was previously considered to be feasible, through the use of the traditional barges.

The Oregon aggregate rail shuttle operation (Section 6.2) and aggregate rail shuttles in other parts of the US suggests that this concept should be considered to help alleviate aggregate shortages in certain parts of BC, which has poor natural aggregates deposits. The existence of rail lines in BC may provide bulk transportation cost advantages for aggregates, which are not possible by considering only truck hauling alternatives.

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